CTE Workshop Proceedings, 2025, Vol. **12**, pp. 498–544 https://doi.org/10.55056/cte.669

Educational technology for gender mainstreaming in project management: Advances in training approaches and digital tools

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Abstract. In recent years, the concept of gender mainstreaming in project management has become more popular and in demand, while educational technology has emerged as a powerful tool for implementing gender training. This paper explores the intersection of educational technology, gender mainstreaming, and project management, with a particular focus on training approaches for ensuring effectiveness and gender-sensitivity in local development projects. We examine the evolution of digital tools and platforms for gender training, e-learning approaches to gender mainstreaming education, case studies of educational interventions, and evaluation metrics for technology-enabled gender training. The study presents a comprehensive analysis of how educational technology can enhance gender training in project management contexts, particularly within international donor programs supporting Ukrainian local communities' development. Our findings reveal that while blended learning approaches and virtual learning environments show promise, significant challenges remain in designing culturally appropriate, accessible technology-enhanced learning experiences that effectively promote gender equality in project management. The paper concludes with recommendations for educational institutions, project management organizations, and international development agencies to leverage educational technology for more effective gender mainstreaming in project management training.

Keywords: educational technology, gender mainstreaming, project management, e-learning, gender training, digital tools, international development, evaluation metrics, blended learning

1. Introduction

Gender mainstreaming has emerged as a critical strategy for promoting gender equality across various spheres, including project management. The concept refers to the process of assessing the implications for women and men of any planned action,

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including policies, programs, and projects, to ensure that both genders benefit equally [17]. Since the 1995 Beijing Platform for Action explicitly called upon governments and other actors to promote gender mainstreaming, the strategy has gained traction globally, particularly in international development contexts [20].

Concurrently, educational technology has revolutionized how training and professional development are delivered, offering unprecedented opportunities to enhance gender mainstreaming efforts in project management. As educational technology continues to evolve – from basic e-learning platforms to sophisticated virtual reality environments – it provides innovative approaches to address gender disparities in project management knowledge, skills, and attitudes [28].

The importance of diversity in project management has been emphasized by numerous researchers [1, 23, 35]. Okoro [35] considered prioritizing diverse talent as a key resource for enhancing project success, with increasing women's participation in project management being a significant pathway to achievement. Despite this recognition, women remain underrepresented in project management, particularly in leadership roles [41]. The Australian Institute of Project Management identified "diversity by default" as a core value but reported that female members constitute only 22% of their membership [1]. McKinsey's research found a statistically significant correlation between gender diversity in leadership and companies' financial performance [23], further highlighting the business case for gender equality in project management.

Educational technology offers promising avenues for addressing gender disparities in project management through innovative training approaches. However, research at the intersection of educational technology, gender mainstreaming, and project management remains limited. This paper aims to bridge this gap by exploring how educational technology can enhance gender mainstreaming in project management training, particularly within the context of international donor programs supporting local development projects.

The paper addresses the following research questions: How are digital tools and platforms used in gender training for project managers? What e-learning approaches effectively promote gender mainstreaming in project management education? What case studies demonstrate successful educational technology interventions for gender mainstreaming in project management? What evaluation metrics effectively measure the impact of technology-enabled gender training? How can educational technology enhance gender mainstreaming in Ukrainian local development projects?

The paper is organized as follows: section 2 reviews the literature on gender mainstreaming, women in project management, and educational technology applications in gender training. Section 3 outlines the methodological framework. Sections 4-8 present findings on e-learning approaches, digital tools and platforms, case studies, evaluation metrics, and applications in Ukrainian local development projects. Section 9 provides recommendations for practice, and Section 10 concludes with future research directions.

2. Literature eeview

2.1. Gender mainstreaming in programs and projects: concept evolution (2020-2025)

Gender mainstreaming as a concept has evolved significantly since its formal inclusion in the Beijing Platform for Action in 1995. Recent literature (2020-2025) highlights a shift from viewing gender mainstreaming as primarily a policy strategy to recognizing it as an integral component of project cycle management that requires specific tools, methodologies, and training approaches [9].

Caywood and Darmstadt [9] conducted a comprehensive review of 27 years of peer-reviewed literature on gender mainstreaming (1995-2022) and found that while publications on the topic have increased, they primarily come from authors with European and USA academic affiliations. The study identified key challenges in implementing gender mainstreaming, including conceptual clarity, academic-practitioner disjunctures, politics, leadership and organizational culture, men's roles, intersectionality, and monitoring and evaluation.

Recent developments in gender mainstreaming focus on its integration into various sectors, with health and law/policy being the most frequently researched areas [9]. However, there is growing interest in gender mainstreaming in project management, particularly in international development contexts where projects serve as vehicles for social change [39].

Miske, Meagher and DeJaeghere [32] argue that gender mainstreaming in basic education has received limited attention, especially at the operational level (i.e., field offices in partnership with communities, schools, and classrooms). They contend that gender analysis in education could be enhanced through robust education and gender (EDGE) analysis frameworks that integrate dimensions of educational quality and attainment with equality and empowerment.

A significant development in recent years is the recognition of gender mainstreaming as not merely an "add-on" to project work but rather an integral component of project cycle management that influences all phases of project design, implementation, monitoring, and evaluation [20]. This perspective has prompted the development of specific tools and methodologies for integrating gender mainstreaming into project management processes.

2.2. Women in project management: current state and challenges

Despite increasing awareness of the importance of gender diversity in project management, women remain underrepresented in the field, particularly in leadership roles. Recent bibliometric analyses of publication patterns in educational technology journals have revealed significant gender disparities, with women publishing less than half of the articles in prominent journals [45]. However, Bond [6] found that the International Journal of Educational Technology in Higher Education has achieved gender parity in authorship, suggesting progress in some areas.

Research on women as project managers has explored various aspects of their experiences, challenges, and contributions. Henderson, Stackman and Koh [22] examined women project managers as a group within their professional context, identifying their project challenges and perspectives. The study found significant associations among women project managers' career, age, cost of their projects, and professional certifications. Women over 50 years old were more likely to have project management certification and to have managed more costly projects.

Pritchard and Miles [41] explored why women continue to be underrepresented in the leadership of major projects, identifying three key factors: (1) the prevalence of STEM subjects and "project-dense" sectors that remain predominantly male; (2) challenges of balancing leadership roles with other responsibilities, particularly caregiving; and (3) social judgments and ideals of leadership that are influenced by gender stereotypes.

Women project managers reportedly face both advantages and disadvantages in their profession. Advantages include strengths in communication, collaboration, and building professional relationships; context-sensitive and empathetic management styles; competence in team management; and unique manifestations of themselves in their roles [22]. Disadvantages include exclusion from male-dominated power circles; credibility gaps; negative stereotyping; and being dismissed or discounted by male colleagues [22].

In Ukraine, gender disparities in project management are particularly pronounced. According to data from the Ukrainian Project Management Association, only 27.8% of certified project managers are women [13]. Additionally, there is a significant gender pay gap, with women earning about 20% less than men for comparable work [44]. These disparities highlight the need for effective gender mainstreaming strategies in project management education and training.

2.3. Educational technology applications in gender training

Educational technology offers promising avenues for addressing gender disparities in project management through innovative training approaches. Lukhmanov, Perveen and Tsakalerou [28] proposed a framework for designing gender-inclusive mobile learning experiences, emphasizing the importance of addressing gender bias in educational content, teaching methodologies, and assessment techniques. The study found that gender inclusivity in mobile learning requires focused educator training, development of inclusive materials and examples, use of gender-neutral language and visuals, inclusion of diverse references, and equitable assessment procedures.

Virtual Learning Environments (VLEs) have been used to simulate real-world contexts of international development to develop an applied critical understanding of gender analysis and gender mainstreaming [34]. These environments provide opportunities for experiential and work-integrated learning, facilitating knowledge contextualization and preparing students for complex work scenarios.

E-learning platforms specifically designed for gender training, such as the eGender platform, have shown promise in providing evidence-based learning materials for sex and gender-specific education [47]. The platform follows a blended learning pedagogical concept and offers modules on basic knowledge and specific disciplines, with tools for online communication and collaborative work.

Interactive e-learning modules have been used to improve knowledge, self-efficacy, and behavior regarding the integration of sex and gender in research proposals and publications. Tannenbaum and Van Hoof [49] found that such modules resulted in improved knowledge (62-84% of participants) and increased self-efficacy (77-86% of participants) across various competencies related to sex and gender integration in health research.

2.4. Digital approaches to gender mainstreaming education

Digital approaches to gender mainstreaming education encompass a range of methodologies, platforms, and tools designed to enhance the effectiveness of gender training. Wiepcke and Mittelstaedt [54] proposed a set of standard rules for gender-sensitive integrated e-learning and classroom learning, emphasizing the importance of considering female learning characteristics when developing training measures.

Blended learning approaches have been particularly effective in enhancing gender mainstreaming, as demonstrated by the “E-Office Management” program in Germany [55]. The evaluation of this program illustrated that gender-sensitive further education measures can contribute significantly to the enhancement of gender mainstreaming.

Mobile learning (m-learning) has emerged as a promising approach for gender-inclusive education. Lukhmanov, Perveen and Tsakalerou [28] developed a framework for designing gender-inclusive mobile learning experiences based on a survey of instructors from various disciplines. The framework focuses on educator training, inclusive materials and examples, gender-neutral language and visuals, diverse references, and equitable assessment procedures.

Project-Based Learning (PBL) has been found to be effective in addressing gender disparities in STEM fields. Fontes, Mohallem Paiva and Berton [19] conducted a case

study where first-year technology students were tasked with developing a job-matching website for women pursuing STEM careers. The study found promising results regarding the worth of PBL adoption in computing courses, particularly concerning the development of important technical and behavioral skills for female undergraduates.

2.5. Theoretical frameworks linking educational technology, gender mainstreaming, and project management

Several theoretical frameworks have been proposed to understand the intersection of educational technology, gender mainstreaming, and project management. Yang [56] conducted a case study at a university employing action research to develop a four-point strategy for gender mainstreaming on campus. The study evolved practical knowledge and strategies for transforming gender mainstreaming concepts into practices, which can be applied to develop a reference model for promoting gender mainstreaming in higher educational institutions.

The Knowledge, Attitude, Skills (KAS) model has been used to measure the efficacy of gender training at individual and organizational levels. Kuppuswami and Ferreira [25] applied this model to evaluate an online training program on gender equality and women's empowerment, defining different dimensions of capacities with three learning domains – Cognitive, Affective, and Psychomotor (Bloom's Taxonomy).

The Technology Adoption Model (TAM) has been used to examine the influence of gender on the acceptance of educational technologies. Rana and Chicone [43] used TAM to measure the perceived usefulness and ease of use of Virtual Reality (VR) cybersecurity training platforms, considering gender as a predictor of how individuals perceive these technologies.

Sitzmann and Weinhardt [48] proposed a multilevel framework for training evaluation that addresses criteria at within-person, between-person, and macro levels of analysis. This framework identifies four evaluation taxa – training utilization, affect, performance, and financial impact – and articulates when it is appropriate to aggregate responses from a lower level of analysis to assess training effectiveness at a higher level.

Leitner, Hann and Kickmeier-Rust [26] developed the NEON evaluation framework for educational technologies, which serves as a conceptual starting point for setting up evaluation activities. The framework focuses on the mutual dependence between evaluation dimensions and evaluation procedures, offering short instruments that provide valid and reliable results comparable to those of longer standard test batteries.

3. Methodological framework

3.1. Research approach

This study employs a mixed-methods approach, combining qualitative and quantitative methodologies to explore the intersection of educational technology, gender mainstreaming, and project management. The mixed-methods design allows for a comprehensive understanding of both the breadth and depth of the phenomenon under investigation [12].

The qualitative component includes systematic review, document analysis, and case study examination to identify patterns, themes, and insights regarding educational technology applications in gender mainstreaming for project management. The quantitative component involves analysis of existing datasets, surveys, and evaluation metrics to assess the effectiveness of technology-enabled gender training.

The research is guided by a pragmatic paradigm, which acknowledges that multiple realities exist and focuses on practical solutions to research problems [12]. This paradigm is particularly appropriate for this study, as it enables the integration of diverse perspectives and methodologies to address complex, real-world issues

at the intersection of educational technology, gender mainstreaming, and project management.

3.2. Data collection methods

Data for this study were collected through multiple methods to ensure comprehensiveness and triangulation. A systematic literature review was conducted, examining peer-reviewed journal articles, conference proceedings, and books published between 2020 and 2025. This review focused on the intersection of educational technology, gender mainstreaming, and project management, yielding 528 articles that were screened for relevance. After careful screening, 94 articles were included in the final analysis.

Official documents from international organizations, governmental bodies, and non-governmental organizations were analyzed to understand policies, guidelines, and frameworks related to the research focus. These documents provided valuable insights into formal approaches to gender mainstreaming in project management and the role of educational technology in these contexts.

Detailed case studies of educational technology interventions in gender mainstreaming for project management constituted another important data source. Cases were selected based on relevance, comprehensiveness, and potential for transferability to other contexts, with an emphasis on diversity in geographical locations, technological approaches, and project management domains.

Existing survey data from relevant studies were compiled and analyzed, supplemented by an original online survey conducted with 120 project management professionals and trainers. This survey gathered insights on experiences with technology-enabled gender training, including perceived benefits, challenges, and areas for improvement.

Data on evaluation metrics used to assess the effectiveness of technology-enabled gender training were collected from published studies, training programs, and organizational reports. These metrics provided quantitative measures of the impact of various approaches and interventions.

3.3. Analysis techniques

The analysis of data employed both qualitative and quantitative techniques, appropriate to the nature of the data and research questions. Qualitative data from the literature review, document analysis, and case studies underwent thematic analysis following Braun and Clarke [7]'s six-step process: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. This approach allowed for the identification of patterns, themes, and insights across diverse sources.

Document analysis employed content analysis techniques to systematically categorize and interpret textual data from policies, guidelines, and frameworks. This analysis revealed structural patterns and thematic emphases in formal approaches to gender mainstreaming in project management education.

Quantitative data from surveys and evaluation metrics were analyzed using descriptive statistics to identify central tendencies, distributions, and patterns. This analysis provided a foundation for understanding the landscape of technology-enabled gender training and its effectiveness across various contexts.

Cross-case analysis compared findings across different contexts, identifying commonalities, differences, and potential influencing factors. This comparative approach enhanced the transferability of findings and highlighted contextual considerations in the application of educational technology for gender mainstreaming in project management.

Findings from different data sources and analysis techniques were triangulated to

enhance validity and reliability, providing a more robust foundation for conclusions and recommendations.

3.4. Limitations

Several important limitations must be acknowledged when interpreting the findings of this study. Language bias presents a significant consideration, as the literature review primarily included English-language publications. This limitation potentially excluded relevant studies published in other languages, particularly from non-Western contexts where gender dynamics and educational approaches may differ substantially.

Publication bias represents another limitation, as the study relied heavily on published literature. This reliance may skew findings toward positive results, which are more likely to be published than negative or null findings. This bias is particularly relevant in educational technology research, where failed interventions or approaches may be underreported.

The application of educational technology for gender mainstreaming in project management is highly context-dependent, with findings from one context potentially not transferable to others due to differences in cultural, social, economic, and technological factors. While the study attempted to account for these differences, the diversity of contexts limits the generalizability of findings.

The quality of evidence in the field varies considerably, with many studies lacking rigorous methodological designs. This variability affects the strength of conclusions that can be drawn and highlights the need for more methodologically robust research in this area.

The rapid evolution of educational technology presents a temporal limitation, as findings related to specific technologies may quickly become outdated. Technologies that were cutting-edge during the study period may be replaced by newer approaches, potentially limiting the longevity of specific technological recommendations.

Despite these limitations, the mixed-methods approach and triangulation of data sources enhance the robustness of the findings and their potential contribution to the field. The study provides valuable insights into the current state of educational technology for gender mainstreaming in project management while acknowledging the need for ongoing research and adaptation to changing contexts and technologies.

4. E-Learning approaches to gender mainstreaming education

4.1. Blended learning approaches and models

Blended learning approaches have emerged as particularly effective for gender mainstreaming education in project management. These approaches, which combine online and face-to-face components, create multiple entry points for engagement with gender concepts and accommodate diverse learning preferences. This flexibility is especially valuable when addressing complex and sometimes sensitive gender-related topics in project management contexts [55].

Research by Wiepcke, Mittelstaedt and Liening [55] examined a blended learning program called “E-Office Management” in Germany, specifically designed to address gender inequalities in the labor market. The study revealed that incorporating female learning characteristics into the design of training measures significantly enhanced gender mainstreaming outcomes. The program’s evaluation led to the development of standard guidelines for gender-sensitive, computer-assisted learning environments.

Several effective models have emerged in the literature, including rotation approaches where learners alternate between self-paced online learning and facilitated face-to-face sessions. This structure allows for personalized learning while maintaining the benefits of interpersonal interaction [54]. Another valuable approach is the

flex model, where online learning forms the instructional backbone, supplemented by face-to-face support as needed for challenging concepts [53].

The effectiveness of blended learning for gender mainstreaming education appears to be influenced by multiple factors. Venkatesh et al. [53] identified learner characteristics (including gender and age), cognitive factors (such as performance expectations), and social environment (learning climate) as significant predictors of learner satisfaction. Interestingly, the study found gender differences in satisfaction levels, with male students reporting higher computer self-efficacy and overall satisfaction compared to female students.

One of the most compelling advantages of blended learning for gender mainstreaming is the creation of safe spaces for exploring sensitive topics. Online components provide privacy for individual reflection on gender biases and stereotypes, while face-to-face sessions facilitate deeper dialogue and exchange of perspectives [34]. This combination creates particularly rich learning environments for addressing gender issues in project management contexts.

4.2. Virtual learning environments for gender training

Virtual learning environments offer innovative approaches to gender training by simulating real-world contexts that demonstrate gender dynamics in project management. These environments allow learners to engage with gender issues in ways that would be difficult to replicate in traditional training settings. Mundkur and Ellickson [34] described the development of a VLE simulating international development contexts to foster critical understanding of gender analysis and mainstreaming. Their research concluded that these environments provide valuable opportunities for experiential learning, helping to contextualize knowledge and prepare learners for the complexities of project environments.

Effective VLEs for gender training in project management typically incorporate scenario-based learning with interactive situations reflecting real-world gender issues in project contexts. These scenarios allow learners to practice decision-making and observe consequences in a safe environment [34]. Role-playing opportunities enable participants to adopt different perspectives within a project team, enhancing empathy and understanding of diverse experiences [40].

The design of VLEs significantly influences their effectiveness for gender training. Farmer [18] emphasized the importance of gender-sensitive instructional design in online environments, noting that while virtual spaces can sometimes mask gender issues, learners inevitably bring their experiences and attitudes to the educational setting. The author proposed instructional design strategies to support gender-equitable engagement in online education, particularly addressing Western societal contexts.

A significant advantage of VLEs is their ability to create what Mundkur and Ellickson [34] termed a "third space" for learning – neither purely academic nor purely workplace-based. This intermediate space allows learners to safely explore gender dynamics without real-world consequences while still engaging with authentic scenarios. This feature proves particularly valuable for preparing project managers to navigate complex gender issues across diverse cultural contexts.

4.3. Mobile learning frameworks for gender inclusion

Mobile learning has emerged as a promising approach for gender mainstreaming education, particularly in contexts where access to traditional educational resources may be limited. The increasing ubiquity of mobile devices creates opportunities for reaching diverse learners, including those in remote or resource-constrained environments [28].

Research by Lukhmanov, Perveen and Tsakalerou [28] led to the development of a framework for designing gender-inclusive mobile learning experiences based on a survey of 24 instructors from various disciplines. Their framework emphasizes the importance of focused educator training to recognize and address gender biases in mobile learning environments. The development of inclusive materials that represent diverse gender perspectives and experiences forms another core component, alongside the use of gender-neutral language and inclusive visual representation.

The study revealed significant insights about the current state of gender inclusivity in mobile learning. Gender bias in mobile learning environments can potentially exacerbate existing gender disparities in education, highlighting the need for intentional design approaches. The framework proposes ongoing evaluation and enhancement of gender inclusivity practices, along with contextual adaptation that respects cultural contexts while promoting gender equality.

The portability and flexibility of mobile learning create unique advantages for gender mainstreaming education in project management. Mobile applications can deliver just-in-time learning at the point of need, allowing project managers to access gender-related guidance when confronting specific situations. This contextual relevance enhances the application of learning to real-world project scenarios [28].

However, mobile learning for gender mainstreaming also presents challenges. Digital divides along gender lines persist in many contexts, with women often having less access to and familiarity with mobile technologies [50]. Effective implementation requires addressing these disparities to ensure that mobile learning approaches do not inadvertently reinforce existing gender inequalities.

4.4. Interactive e-learning modules for gender equality

Interactive e-learning modules have demonstrated considerable promise for gender equality training in project management contexts. These modules leverage digital interactivity to engage learners with gender concepts and practices, promoting deeper understanding and application. Tannenbaum and Van Hoof [49] studied the effectiveness of online learning modules designed to improve researchers' capacity to appropriately integrate sex and gender in grant proposals. Their analysis of pre- and post-test scores from 1,441 individuals revealed significant improvements in knowledge, self-efficacy, and self-reported intent to change behavior.

The most effective modules incorporate several key pedagogical approaches. Problem-based learning scenarios present realistic gender-related challenges in project contexts, requiring learners to apply gender analysis and mainstreaming principles to develop solutions. Interactive case studies illustrate gender issues in project management through narrative-based scenarios with decision points that affect outcomes. Guided reflection prompts encourage learners to examine their own assumptions, biases, and experiences related to gender in professional contexts.

The eGender platform described by Seeland et al. [47] exemplifies the potential of interactive e-learning for gender mainstreaming. This web-based knowledge-sharing platform was designed to support blended learning in sex and gender medicine. The platform comprises both English and German versions of e-learning modules, with one focusing on basic knowledge and seven on specific medical disciplines. Each module consists of several courses corresponding to a disease or symptom complex. Self-organized learning is facilitated through various learning tools, including texts, audiovisual material, and tools for online communication and collaborative work.

An evaluation of the eGender platform found that more than 90 users from Europe registered for the learning modules. The most frequently accessed module was "Gender Medicine - Basics", and users showed a preference for discussion forums. These e-learning modules fulfilled quality criteria for higher education and were integrated

into an accredited Master of Public Health program.

The flexibility of e-learning modules allows for customization to specific project management contexts and learner needs. Modules can be designed with varying levels of complexity and depth, accommodating different knowledge levels and learning objectives. This adaptability makes them particularly valuable for gender mainstreaming education, which must address diverse learner backgrounds and organizational contexts [47].

4.5. Gender-sensitive instructional design in online environments

Gender-sensitive instructional design in online environments represents a critical consideration for effective gender mainstreaming education in project management. This approach recognizes that online learning spaces are not gender-neutral and seeks to create inclusive digital environments that address the needs and experiences of diverse learners [18].

Farmer [18] emphasized that while online learning can sometimes mask gender issues, learners inevitably bring their experiences and attitudes to the educational setting. The author proposed instructional design strategies to support gender-equitable engagement in online education, particularly addressing Western societal contexts. These strategies include careful consideration of language, examples, visuals, and interaction patterns in online courses.

Gender-sensitive instructional design in online environments begins with an awareness of potential gender biases in content selection and presentation. López-Martínez and Gómez-Torres [29] conducted a study of undergraduate satisfaction with e-learning teaching practices, taking a gender perspective into account. The research revealed significant differences in satisfaction levels between genders, with female students reporting higher levels of satisfaction with the use of e-learning platforms. These findings highlight the importance of considering gender differences in the design and evaluation of online learning experiences.

Course content and materials require particular attention to ensure gender inclusivity. This includes using diverse examples that reflect various gender perspectives and experiences, avoiding stereotypical representations, and acknowledging the contributions of people of all genders to the field of project management [28]. Assessment methods also merit careful consideration, as different assessment approaches may advantage or disadvantage learners based on gender-associated learning preferences or experiences.

The facilitation of online discussions presents another important aspect of gender-sensitive instructional design. Research has shown that online discussion forums can replicate gender-based communication patterns found in face-to-face settings, with men sometimes dominating discussions or receiving more responses [18]. Strategies to address these patterns include establishing clear participation guidelines, actively moderating discussions to ensure equitable participation, and using structured discussion formats that encourage contributions from all learners.

Feedback mechanisms constitute a final critical element of gender-sensitive instructional design. Providing constructive, growth-oriented feedback that acknowledges learners' strengths and offers specific guidance for improvement supports the development of all learners, regardless of gender [53]. This approach is particularly important in project management education, where feedback can significantly influence learners' self-efficacy and professional identity development.

5. Digital tools and platforms for gender training in project management

5.1. Overview of specialized platforms and tools

The landscape of digital tools and platforms for gender training in project management has expanded significantly in recent years, reflecting growing recognition of the importance of gender mainstreaming in this field. These specialized technologies range from comprehensive learning management systems designed specifically for gender training to targeted tools addressing particular aspects of gender in project contexts [47].

The eGender platform represents one notable example of a specialized learning environment for gender-related education. Developed initially for sex- and gender-specific medical education, this web-based interactive knowledge-sharing platform has demonstrated effectiveness in promoting understanding of gender-related concepts and practices [47]. The platform's design follows the constructivist didactic concept, with learning materials developed by experts from multiple universities. This collaborative approach to content development ensures high-quality, evidence-based learning materials that reflect diverse perspectives.

Beyond comprehensive platforms, targeted digital tools address specific aspects of gender mainstreaming in project management. Gender analysis tools support the systematic examination of gender differences in project contexts, helping project managers identify potential gender impacts and opportunities for promoting equality. Gender-responsive budgeting tools assist in analyzing and developing project budgets that allocate resources equitably and address gender-specific needs. Gender impact assessment tools facilitate the evaluation of potential gender effects of project decisions and activities, supporting more gender-sensitive project planning and implementation [10].

Collaborative digital environments facilitate knowledge sharing and community building among project managers interested in gender mainstreaming. These environments include discussion forums, virtual communities of practice, and collaborative workspaces where practitioners can share experiences, resources, and best practices related to gender in project management [47]. Such environments are particularly valuable for building support networks and fostering ongoing professional development in gender mainstreaming approaches.

Emerging technologies are expanding the possibilities for gender training in project management. Virtual and augmented reality technologies offer immersive learning experiences that allow project managers to experience gender-related scenarios from different perspectives, potentially enhancing empathy and understanding [43]. Artificial intelligence applications, including chatbots and adaptive learning systems, provide personalized guidance and support for gender mainstreaming in project contexts, adapting to individual learner needs and project scenarios.

5.2. Assessment of effectiveness and accessibility

Assessing the effectiveness and accessibility of digital tools and platforms for gender training in project management involves examining multiple dimensions, including learning outcomes, user experience, inclusivity, and practical impact on project practices. Research in this area reveals both promising results and significant challenges that merit consideration when designing and implementing technology-enabled gender training [26].

Leitner, Hann and Kickmeier-Rust [26] developed the NEON evaluation framework for educational technologies, which offers a structured approach to assessing learning tools based on four dimensions. This holistic framework recognizes the mutual dependence between evaluation dimensions and procedures, providing a valuable foundation for evaluating gender training technologies. The researchers found that

short evaluation instruments (10 items) can provide sufficiently valid and reliable results compared to longer standard tests, potentially reducing the burden of evaluation while maintaining quality.

Studies of specific gender training platforms have shown promising effectiveness results. Tannenbaum and Van Hoof [49] found that interactive e-learning modules on sex and gender integration in research led to improved knowledge in 62-84% of participants and increased self-efficacy in 77-86% of participants across various competencies. These findings suggest that well-designed digital learning environments can effectively enhance gender-related knowledge and confidence in applying gender concepts.

Accessibility represents a critical consideration for digital gender training tools, particularly given persistent digital divides along gender, socioeconomic, and geographical lines [50]. Research by Moreira-Choez et al. [33] on the influence of gender and academic level on the development of digital competencies found that these demographic factors can significantly affect technological exposure and training effectiveness. These findings highlight the importance of designing gender training technologies with awareness of potential barriers to access and use.

Cultural and contextual factors also influence the effectiveness and accessibility of digital gender training tools. Keengwe and Malapile [24] examined factors influencing technology planning in developing countries, identifying both internal factors (e.g., organizational priorities, language dominance in software) and external factors (e.g., global partnerships, multinational corporations) that affect technology implementation. These considerations are particularly relevant for gender training technologies deployed in international development contexts, where cultural, linguistic, and infrastructural differences may significantly impact effectiveness.

User acceptance represents another critical factor in the effectiveness of gender training technologies. Rana and Chicone [43] studied the influence of gender on acceptance of Virtual Reality cybersecurity training platforms using the Technology Acceptance Model. The research examined whether gender predicts how individuals perceive the usefulness and ease of use of VR technologies, finding significant gender-related differences in perception. These findings suggest that gender-responsive design approaches are necessary to ensure that training technologies meet the needs and preferences of diverse users.

5.3. Gender-specific considerations in design and implementation

The design and implementation of digital tools for gender training in project management require careful consideration of gender dynamics and potential biases that might affect learning experiences. Research indicates that technology design often reflects existing gender norms and power structures, potentially reinforcing rather than challenging gender inequalities if not approached thoughtfully [10].

Christou and Parmaxi [10] conducted a systematic review of gender-sensitive tools and materials for women's empowerment in STEM, identifying both traditional and digital approaches. Their findings emphasize that digital tools for gender training must consciously avoid reinforcing stereotypes while providing gender-responsive content that acknowledges diverse experiences. The authors note that effective tools go beyond merely including women in examples to critically examining and addressing underlying gender power dynamics in professional contexts.

Language and representation within digital platforms significantly influence their effectiveness for gender training. Lukhmanov, Perveen and Tsakalerou [28] emphasize the importance of gender-neutral language and inclusive visual content that represents diverse gender identities without reinforcing stereotypes. Their framework for gender-inclusive mobile learning highlights that linguistic choices and visual representations

can either challenge or reinforce existing gender biases, making these elements critical considerations in platform design.

The learning analytics employed in digital platforms also merit careful gender-responsive examination. Moreira-Choez et al. [33] found that gender and academic level influence the development of digital competencies, suggesting that tracking and assessment mechanisms in learning platforms should account for these differences without reinforcing disparities. This might involve ensuring that performance metrics and feedback mechanisms do not inadvertently privilege approaches or styles associated with particular genders.

User interface design represents another crucial consideration, as research suggests that interface preferences and navigation patterns may differ across genders [43]. Designing interfaces that accommodate diverse preferences and approaches enhances accessibility and effectiveness for all learners. This might involve providing multiple navigation pathways, offering various visualization options for data and concepts, and ensuring that aesthetic choices do not alienate particular user groups.

Implementation strategies for digital gender training tools significantly influence their impact. Kuppuswami and Ferreira [25] found that effective implementation of online gender equality training requires adequate institutional support, integration with broader gender equality initiatives, and opportunities for application and practice. Their study highlighted the importance of converting training success into broader gender equality strategies within organizations, suggesting that digital tools should be embedded within comprehensive approaches rather than deployed as standalone solutions.

5.4. Integration with project management methodologies

The integration of gender mainstreaming digital tools with established project management methodologies represents a crucial consideration for ensuring practical relevance and application. This integration requires thoughtful alignment between gender concepts and project management frameworks, creating bridges between theoretical understanding and practical implementation [20].

Research by Miske, Meagher and DeJaeghere [32] examined the integration of gender analysis frameworks with project cycle management in international development contexts. Their study of CARE USA's Common Indicator Framework (CIF) revealed the potential for integrating dimensions of educational quality and attainment with equality and empowerment in basic education projects. The researchers found that robust education and gender analysis frameworks could enhance gender mainstreaming at the operational level, particularly when aligned with project monitoring and evaluation systems.

Digital tools that map gender considerations onto project management process groups – initiating, planning, executing, monitoring and controlling, and closing – provide practical guidance for project managers at each stage of the project lifecycle. This mapping helps translate abstract gender concepts into concrete actions within familiar project management frameworks [20]. Such integration proves particularly valuable for project managers who may understand gender concepts theoretically but struggle to apply them in practical project contexts.

Gender-responsive project management tools have been developed to enhance various aspects of project management practice. Godfroy-Genin, Sagebiel and Beraud [21] described efforts to bridge the gap between gender mainstreaming recommendations and effective action plans in engineering education. The authors emphasized the importance of tailor-made approaches that account for specific cultural and economic contexts, suggesting that digital tools should offer adaptable frameworks rather than rigid prescriptions for gender mainstreaming in projects.

The integration of gender considerations with risk management processes represents another important aspect of alignment with project management methodologies. Digital tools that help project managers identify and address gender-related risks – such as differential impacts on women and men, potential reinforcement of gender inequalities, or backlash against gender equality initiatives – support more comprehensive risk management approaches [20]. Such integration helps project managers recognize gender-related risks as legitimate project concerns rather than peripheral considerations.

Stakeholder engagement processes provide another valuable integration point for gender mainstreaming tools. Digital platforms that support gender-responsive stakeholder analysis, communication planning, and engagement strategies help project managers ensure that diverse perspectives are included throughout the project lifecycle [37]. Such tools might include guidance for identifying and engaging stakeholders who represent diverse gender perspectives and experiences, particularly those who might otherwise be overlooked in traditional stakeholder analyses.

5.5. Emerging technologies in gender training

Emerging technologies are expanding the possibilities for gender training in project management, offering innovative approaches to developing gender awareness, knowledge, and skills. These technologies – including virtual reality, artificial intelligence, gamification, and advanced analytics – create new opportunities for experiential learning, personalization, and impact assessment in gender training [43].

Virtual Reality (VR) technologies offer immersive learning experiences that allow project managers to engage with gender-related scenarios from multiple perspectives. Rana and Chicone [43] studied the influence of gender on acceptance of VR cybersecurity training platforms, finding that VR can provide engaging, interactive learning environments that enhance skill development. Applied to gender training in project management, VR could enable participants to experience project scenarios from different gender perspectives, potentially enhancing empathy and understanding of diverse experiences.

Artificial Intelligence (AI) applications increasingly support personalized learning experiences in digital education. These applications can adapt content, pace, and feedback based on individual learner needs and progress, potentially addressing the diverse backgrounds and knowledge levels of project managers engaging with gender concepts [27]. AI-powered chatbots and virtual assistants can provide just-in-time guidance for applying gender mainstreaming principles in specific project situations, offering practical support for implementing theoretical knowledge.

Gamification approaches leverage game mechanics and design principles to enhance engagement and motivation in learning experiences. Medini and Berger-Douce [30] examined ingredients for digital transformation project trainings, highlighting the potential of gamified approaches to develop complex competencies. Applied to gender training, gamification might involve scenario-based challenges that require applying gender analysis in project decisions, competitive or collaborative activities that promote gender-responsive project planning, or achievement systems that recognize progress in developing gender mainstreaming skills.

Advanced learning analytics offer increasingly sophisticated approaches to tracking and assessing learner engagement, progress, and outcomes in digital environments. These analytics can provide valuable insights into how project managers engage with gender concepts, where they struggle, and how their understanding and application evolve over time [48]. Such insights can inform both individual feedback and broader program improvements, enhancing the effectiveness of gender training initiatives.

These emerging technologies also present challenges that require careful considera-

tion. Digital divides along gender, socioeconomic, and geographical lines may limit access to advanced technologies, potentially exacerbating existing inequalities if not addressed thoughtfully [50]. Privacy concerns arise with technologies that collect extensive data on learner behaviors and characteristics, requiring transparent and ethical approaches to data management. Additionally, the rapid evolution of technologies necessitates ongoing evaluation and adaptation of gender training approaches to leverage new capabilities while ensuring alignment with core learning objectives.

6. Case studies: educational technology interventions

6.1. Project-based learning for women in STEM

Project-Based Learning (PBL) has emerged as a particularly effective educational technology intervention for promoting gender mainstreaming in STEM fields, including project management. This approach engages learners in complex, authentic projects that address real-world challenges, developing both technical and professional skills while creating meaningful connections to gender equality issues [19].

A compelling case study by Fontes, Mohallem Paiva and Berton [19] examined the application of PBL in the development of a job-matching website for women in STEM careers. The study followed first-year technology students at a higher education institution who were tasked with developing this website over a ten-week period. The project served dual purposes: developing web development skills while addressing the issue of female underrepresentation in technology fields. The analysis revealed promising findings regarding the value of PBL adoption in computing courses, particularly concerning the development of important technical and behavioral skills for female undergraduates.

This case demonstrated how educational technology interventions can simultaneously address content learning objectives and gender equality goals. By focusing the project on a platform designed to support women in STEM careers, the intervention made gender issues explicit and relevant to the learning context. Students engaged with research on gender disparities in STEM fields, considered the needs and experiences of women seeking employment in these areas, and developed technical solutions to address identified challenges [19].

The pedagogical approach in this case incorporated several key elements that contributed to its effectiveness. The authentic nature of the project created meaningful connections between academic learning and real-world gender issues in STEM, enhancing student motivation and engagement. The collaborative team structure provided opportunities to experience and address gender dynamics in group work, with instructors facilitating equitable participation and contribution. Regular reflection activities encouraged students to consider gender aspects of both the project content and their team interactions, deepening their understanding of gender issues in STEM contexts [19].

This case study illustrates the potential of PBL as an educational technology intervention for gender mainstreaming in project management education. By engaging students in projects that explicitly address gender equality issues while developing project management skills, educational institutions can foster both technical competence and gender awareness. This integrated approach appears more effective than treating gender as a separate topic disconnected from core technical and professional learning [19].

6.2. Gender mainstreaming in engineering education

Engineering education presents particular challenges for gender mainstreaming due to persistent underrepresentation of women and deeply embedded masculine cultural norms. Several notable case studies have examined educational technology

interventions designed to address these challenges, offering valuable insights for project management education in technical fields [21].

Godfroy-Genin, Sagebiel and Beraud [21] analyzed two significant initiatives: the WOMENG project and the Conference des Grandes Ecoles in France. The WOMENG project identified key moments for action and developed recommendations for gender mainstreaming in engineering education. The Conference des Grandes Ecoles implemented ten targeted actions aimed at attracting and retaining female students in engineering programs. These initiatives confirmed that successful implementation of gender mainstreaming measures requires tailor-made approaches that account for specific cultural and economic contexts. The authors emphasized the importance of a global approach that simultaneously addresses students, faculty, and staff while considering the entire educational pathway from secondary education through professional practice.

A pilot project on gender mainstreaming conducted at the Universitat Politècnica de Catalunya - BarcelonaTech (UPC) during the 2018/2019 academic year provides another instructive case study [39]. This initiative recruited 41 voluntary teachers from eight Bachelor's and Master's Degrees to incorporate gender perspectives into engineering education. The project considered social and gender relevance of subjects, inclusive methodology, classroom management, and assessment approaches. A major outcome was the development of a guide for teaching and research staff to effectively incorporate gender equality goals in engineering teaching and research [39].

Educational technology played a crucial role in these interventions. Digital platforms facilitated the sharing of resources, best practices, and guidance for gender-responsive teaching in engineering contexts. Online communities of practice supported faculty in developing and implementing gender-inclusive approaches, creating spaces for collaborative problem-solving and mutual support. Learning management systems incorporated gender-responsive content, activities, and assessment approaches, providing models for more inclusive engineering education [39].

These case studies highlight several key considerations for gender mainstreaming in engineering education that have relevance for project management training. The importance of institutional commitment and support emerges as a critical factor, with successful interventions requiring leadership engagement and resource allocation. Faculty development represents another crucial element, as instructors need opportunities to develop awareness, knowledge, and skills for gender-responsive teaching. Curricular integration appears more effective than add-on approaches, with gender perspectives incorporated throughout the educational experience rather than isolated in specific courses or modules [21].

6.3. Infrastructural rhetorical analysis in team communication

An innovative educational technology intervention focusing on team communication patterns provides valuable insights for addressing gender disparities in project management education. Adams et al. [2] developed and implemented a method called "infrastructural rhetorical analysis" to improve communication experiences for women in early engineering courses, addressing the marginalization often experienced by women in team settings.

This intervention built upon previous research in engineering education and technical and professional communication to implement classroom strategies aimed at reducing gendered disparities in communication challenges. The researchers applied their methodological approach to an educational case study involving women's experiences in first-year engineering classrooms, determining concrete interventions that could make meaningful differences with minimal resource requirements [2].

The case study revealed that student project teams often divide work along gender-

stereotypical lines, leading to differentiated learning experiences. These patterns affected self-confidence and persistence, particularly for women students. By analyzing team communication patterns through infrastructural rhetorical analysis, the researchers identified subtle but significant ways that typical team interactions marginalized women's contributions and limited their participation in technical aspects of projects [2].

Educational technology played a central role in this intervention through several mechanisms. Digital collaboration platforms were modified to incorporate structures that promoted more equitable participation and contribution recognition. Communication analysis tools helped teams visualize participation patterns, raising awareness of potential gender disparities in team interactions. Reflection prompts integrated into project management software encouraged teams to consider communication dynamics and make adjustments to ensure all members' voices were heard and valued [2].

The intervention demonstrated promising results for improving women's experiences in team-based project work. Participants reported greater satisfaction with team communication, enhanced confidence in sharing ideas, and more equitable distribution of technical work. These outcomes have significant implications for project management education, where team communication represents a fundamental aspect of professional practice [2].

This case highlights the importance of attending to the social and communicative dimensions of project work when designing educational technology interventions for gender mainstreaming. While technical skills development often receives primary attention in project management education, this intervention demonstrates that addressing team dynamics and communication patterns can significantly impact gender equality outcomes. By making typically invisible communication patterns visible and subject to reflection, educational technologies can help disrupt gender-based marginalization in project teams [2].

6.4. Implementation strategies and challenges

The implementation of educational technology interventions for gender mainstreaming in project management education presents both strategic opportunities and significant challenges. Case studies reveal various approaches to implementation, highlighting factors that influence success and obstacles that must be addressed [56].

Yang [56] conducted an action research study at a university to explore the practical knowledge and strategies derived during the process of transforming gender mainstreaming concepts into practices. The research evolved a four-point strategy for fulfilling gender mainstreaming objectives and developed a reference model for promoting gender mainstreaming in higher educational institutions. The study emphasized the importance of discourse development, empirical study, and advocacy for gender movements, integrating these elements into daily activities within the educational context.

Implementation strategies that have demonstrated effectiveness across multiple case studies include phased approaches that begin with pilot initiatives before scaling to broader implementation. This strategy allows for testing and refinement of interventions in specific contexts before wider deployment, enabling adaptation to local needs and constraints [21]. Faculty champions play crucial roles in successful implementation, serving as advocates, models, and resources for colleagues adopting new approaches. Identifying and supporting these champions represents a valuable strategy for overcoming resistance and building momentum for gender mainstreaming initiatives [39].

Integration with existing institutional priorities and initiatives enhances implementation success by aligning gender mainstreaming with recognized organizational goals

rather than positioning it as a competing priority [56]. Data-informed approaches that use assessment results to guide implementation decisions help target resources effectively and demonstrate impact, building support for ongoing efforts. Communities of practice that connect implementers across departments or institutions create valuable support networks for sharing experiences, resources, and solutions to common challenges [39].

Despite these promising strategies, significant challenges affect implementation efforts. Resistance to gender initiatives represents a persistent obstacle, stemming from various sources including skepticism about the relevance of gender to technical fields, concerns about additional workload, and deeper ideological objections to gender equality goals [9]. Limited resources, particularly time and funding, constrain implementation efforts, requiring creative approaches to maximize impact with available means. Competing priorities in educational institutions create challenges for sustaining attention and commitment to gender mainstreaming initiatives over time [56].

Technical barriers also affect implementation, including limited technical infrastructure in some contexts, varying levels of digital literacy among faculty and students, and challenges in integrating gender-responsive approaches with existing educational technologies [50]. Cultural and contextual factors influence implementation, with approaches that succeed in one setting potentially requiring significant adaptation for effectiveness in different cultural, institutional, or national contexts [24].

6.5. Lessons learned from successful interventions

Analysis of successful educational technology interventions for gender mainstreaming in project management education reveals valuable lessons that can inform future initiatives. These lessons emerge from both successes and challenges encountered in diverse contexts, offering guidance for more effective approaches to gender-responsive project management education [25].

The importance of institutional commitment and leadership support appears consistently across successful interventions. Yang [56] found that gender mainstreaming initiatives thrive when they receive visible support from institutional leaders who allocate resources, recognize achievements, and hold the organization accountable for progress. Without this commitment, interventions often remain peripheral and struggle to achieve sustainable impact. This lesson suggests that advocates for gender mainstreaming in project management education should focus on securing leadership engagement and institutional commitment as foundational steps.

Integration with core educational processes and systems emerges as another critical lesson. Peña and de les Valls [39] demonstrated that embedding gender perspectives in curriculum, pedagogy, assessment, and faculty development – rather than treating gender as a separate add-on topic – leads to more sustainable and effective outcomes. This integrated approach helps gender mainstreaming become an inherent aspect of educational practice rather than an extra consideration that can be easily overlooked or discarded when other priorities emerge.

The value of collaborative, participatory approaches to intervention design and implementation represents a third important lesson. Godfroy-Genin, Sagebiel and Beraud [21] found that engaging diverse stakeholders – including students, faculty, staff, and external partners – in developing and implementing interventions enhances relevance, buy-in, and effectiveness. This collaborative approach helps ensure that interventions address actual needs and challenges rather than assumed issues, and it builds a broader base of support for gender mainstreaming efforts.

Data-informed approaches to intervention design, implementation, and evaluation provide another valuable lesson. Kuppuswami and Ferreira [25] demonstrated the im-

portance of establishing clear baseline measures, monitoring progress, and evaluating outcomes to guide ongoing improvement and demonstrate impact. This evidence-based approach helps target resources effectively, identify successful strategies for expansion, and build support by documenting tangible outcomes.

Attention to context and culture significantly influences intervention success. Keengwe and Malapile [24] highlighted the importance of adapting approaches to specific cultural, institutional, and national contexts rather than attempting to transplant interventions wholesale from one setting to another. This lesson suggests that effective gender mainstreaming initiatives must be tailored to the particular gender dynamics, educational traditions, and institutional cultures of the implementation context.

The power of making invisible gender patterns visible constitutes a final important lesson. Adams et al. [2] demonstrated how raising awareness of subtle gender dynamics in team communication could lead to significant changes in behavior and experience. This lesson suggests that educational technology interventions can be particularly effective when they help participants recognize and reflect on gender patterns that might otherwise remain unnoticed and unaddressed.

7. Evaluation metrics for technology-enabled gender training

7.1. Evaluation models and frameworks

Robust evaluation of technology-enabled gender training requires appropriate models and frameworks that capture multiple dimensions of effectiveness and impact. Several evaluation approaches have demonstrated particular value for assessing gender training interventions, offering structured ways to examine outcomes at individual, organizational, and societal levels [48].

The Kirkpatrick model, originally developed for training evaluation in corporate settings, has been adapted for assessing gender training effectiveness. This four-level approach examines reaction (participants' satisfaction with the training), learning (acquisition of knowledge and skills), behavior (application of learning in practice), and results (broader organizational or social impacts) [15]. Dhliwayo and Nyanumba [15] applied this model to evaluate an on-the-job training program, finding it valuable for comprehensive assessment across multiple dimensions. When adapted for gender training in project management, this model helps track progression from initial engagement through practical application and ultimate impact on gender equality in project contexts.

Sitzmann and Weinhardt [48] proposed a multilevel framework that addresses evaluation criteria at within-person, between-person, and macro levels of analysis. This approach identifies four evaluation taxa – training utilization, affect, performance, and financial impact – while articulating when aggregation of responses from lower to higher analysis levels is appropriate. This framework proves particularly valuable for understanding how individual learning experiences translate to team, organizational, and broader professional outcomes in gender mainstreaming initiatives.

The NEON evaluation framework developed by Leitner, Hann and Kickmeier-Rust [26] offers another valuable approach specifically designed for educational technologies. This framework focuses on the mutual dependence between evaluation dimensions and procedures, providing a conceptual starting point for setting up evaluation activities. Research comparing short (10-item) instruments with standard test batteries (231 items) found that short versions can provide sufficiently valid and reliable results, potentially reducing evaluation burden without sacrificing quality.

Gender-specific evaluation frameworks have also emerged, addressing the particular challenges and goals of gender training. The Knowledge, Attitude, Skills (KAS) model applied by Kuppuswami and Ferreira [25] measures the efficacy of gender training

at individual and organizational levels by defining different dimensions of capacities within three learning domains – cognitive, affective, and psychomotor (based on Bloom's Taxonomy). This approach aligns particularly well with gender training objectives, which typically target changes in understanding, attitudes, and practices related to gender equality.

Theory of Change (ToC) approaches offer valuable frameworks for evaluating complex interventions like gender mainstreaming initiatives. These approaches articulate the causal pathways through which interventions are expected to achieve desired outcomes, identifying assumptions, intermediate changes, and contextual factors that influence success [9]. For gender training in project management, ToC approaches help articulate how specific learning experiences are expected to influence individual practice, team dynamics, organizational policies, and ultimately, gender equality outcomes in project contexts.

7.2. Knowledge, Attitude, Skills (KAS) model

The Knowledge, Attitude, Skills (KAS) model provides a particularly valuable framework for evaluating technology-enabled gender training in project management contexts. This approach aligns closely with the multidimensional nature of gender mainstreaming competence, which encompasses cognitive understanding, affective orientation, and practical application capabilities [25].

Kuppuswami and Ferreira [25] applied the KAS model to evaluate an online training program on gender equality and women's empowerment, defining different dimensions of capacities using three learning domains from Bloom's Taxonomy – Cognitive, Affective, and Psychomotor. The researchers established baseline and end-line KAS measurements at the individual level across six core gender capacities, enabling comparison of pre- and post-training competencies. Their analysis revealed clear positive outcomes regarding improved knowledge, attitudes, and skills that participants could apply in their work.

The knowledge dimension of the KAS model examines cognitive understanding of gender concepts, principles, and applications relevant to project management. Evaluation metrics in this dimension might assess comprehension of key gender terminology, recognition of gender issues in project contexts, awareness of gender analysis frameworks, and understanding of gender mainstreaming approaches appropriate for different project phases [31]. These metrics typically employ pre- and post-training assessments to measure knowledge acquisition and retention.

The attitude dimension focuses on affective orientation toward gender equality and commitment to gender-responsive project management practices. Metrics in this dimension might examine beliefs about gender roles and capabilities, recognition of the value of gender diversity in project teams, motivation to address gender issues in project contexts, and self-efficacy regarding gender mainstreaming activities [31]. These metrics often employ attitudinal scales and reflective assessments to capture changes in orientation and commitment.

The skills dimension addresses practical capabilities for implementing gender-responsive project management. Metrics in this dimension might assess abilities to conduct gender analysis in project contexts, develop gender-responsive project plans, facilitate inclusive team dynamics, address gender-based conflicts or biases, and evaluate projects from gender perspectives [25]. These metrics typically employ performance assessments, simulations, case analyses, or workplace application reports to measure practical capabilities.

The KAS model proves particularly valuable for technology-enabled gender training because it addresses both immediate learning outcomes and potential for practical application. By examining changes across all three dimensions, evaluators gain

insights into not only what participants know but also how they feel about applying that knowledge and whether they can effectively do so in practice. This comprehensive assessment aligns with the multifaceted goals of gender mainstreaming in project management, which requires not just technical understanding but also commitment and practical implementation skills [25].

7.3. Technology Adoption Model (TAM)

The Technology Adoption Model (TAM) offers valuable insights for evaluating the acceptance and utilization of digital platforms for gender training in project management. This model focuses on perceived usefulness and ease of use as key factors influencing whether individuals will adopt and continue to use technological innovations, providing a foundation for understanding how gender training technologies are received and implemented [43].

Rana and Chicone [43] employed TAM to examine the influence of gender on acceptance of Virtual Reality (VR) cybersecurity training platforms. Their study measured perceived usefulness and ease of use to determine whether gender predicts how individuals perceive VR technologies for conducting training. This research demonstrates how TAM can be applied to understand gender differences in technology perception and adoption, offering valuable insights for designing gender-responsive training platforms.

In the context of technology-enabled gender training, perceived usefulness metrics assess whether participants believe the technology enhances their ability to understand and apply gender concepts in project management contexts. These metrics might examine perceptions of relevance to professional practice, alignment with learning needs, enhancement of capabilities, and potential for improving project outcomes through gender-responsive approaches [43]. Higher perceived usefulness scores correlate with greater motivation to engage with and apply learning from digital gender training platforms.

Perceived ease of use metrics focus on how user-friendly and accessible participants find the technology. These metrics might assess perceptions of intuitive navigation, clear instructions, manageable cognitive load, and comfortable integration with existing work processes [43]. Lower perceived ease of use creates barriers to engagement and application, potentially limiting the effectiveness of otherwise valuable gender training content.

TAM metrics typically employ structured questionnaires with Likert-scale items addressing various aspects of perceived usefulness and ease of use. These instruments can be administered before, during, and after training to track changes in perceptions as participants gain familiarity with the technology. Supplementary open-ended questions often provide valuable qualitative insights into specific features or aspects that enhance or detract from usefulness and usability [4].

Research by Al-Swidi and Al Yahya [4] on gender differences in training transfer intention and training effectiveness offers additional perspectives relevant to TAM evaluation. Their study employed structural equation modeling to examine how gender influences perceptions of training value and application. Findings indicated that learning style and supervisor support significantly determine training transfer intention across both male and female samples, though the variance explained by the model was greater for male participants. These results suggest the importance of considering gender differences in technology adoption and training transfer when evaluating digital gender training platforms.

The TAM approach complements other evaluation frameworks by focusing specifically on technology acceptance factors that may enable or constrain the effectiveness of digital gender training initiatives. By understanding how different users perceive and

engage with training technologies, evaluators can identify potential barriers to adoption and application, informing improvements to technological design and implementation strategies [43].

7.4. Self-efficacy and behavioral change metrics

Self-efficacy and behavioral change metrics provide crucial insights into the transformative potential of technology-enabled gender training in project management. These metrics focus on participants' confidence in their ability to apply gender-responsive approaches and their actual implementation of these approaches in practice, addressing the gap between knowledge acquisition and practical application that often challenges training effectiveness [31].

Miralles-Cardona, Kitta and Cardona-Moltó [31] explored pre-service STEM teachers' capacity to teach using a gender-responsive approach, employing the Teacher Self-Efficacy for Gender Equality Practice (TEGEP) scale. Their research examined measurement invariance across countries (Greece and Spain) and sexes (male and female), finding that the scale demonstrated acceptable measurement properties for comparing groups. Results revealed that STEM students completed their master studies without sufficient confidence in gender knowledge, skills, and attitudes to practice gender-sensitive teaching. This study demonstrates the value of self-efficacy measurement in identifying gaps between theoretical understanding and practical confidence.

Self-efficacy metrics for gender training in project management typically assess participants' confidence in performing various gender mainstreaming activities. These might include conducting gender analysis in project contexts, developing gender-responsive project plans, facilitating inclusive team dynamics, addressing gender-based conflicts or biases, communicating with stakeholders about gender issues, and evaluating projects from gender perspectives [31]. Such metrics often employ self-rating scales asking participants to assess their confidence in performing specific tasks or handling particular situations.

Behavioral change metrics focus on actual implementation of gender-responsive approaches in project management practice. These metrics might track behaviors such as conducting gender analysis during project planning, allocating resources to address gender-specific needs, implementing inclusive team communication practices, considering gender impacts in risk assessment, collecting gender-disaggregated data for monitoring, and incorporating gender perspectives in evaluation [49]. Behavioral metrics typically employ self-reported implementation measures, observation protocols, artifact analysis (examining project documents for gender considerations), or 360-degree feedback mechanisms capturing perspectives from colleagues and stakeholders.

Tannenbaum and Van Hoof [49] employed both self-efficacy and behavioral change metrics in evaluating online learning modules designed to improve health researchers' capacity to integrate sex and gender in grant proposals. Their study measured knowledge, self-efficacy, and self-reported intent to change behavior, finding improvements across all three dimensions. Notably, 95% of participants reported an intent to change their behavior regarding sex and gender in health research, suggesting high potential for practical application of learning.

The relationship between self-efficacy and behavioral change represents a particularly important consideration in evaluation. Research by Al-Swidi and Al Yahya [4] found that self-efficacy significantly influenced training transfer intention (the intent to apply learning in practice), which in turn predicted training effectiveness. These findings highlight the value of measuring both self-efficacy and behavioral intentions as predictors of actual implementation, providing early indicators of potential training impact before longer-term behavioral changes can be observed.

Technology-enabled gender training offers unique opportunities for capturing self-efficacy and behavioral data through digital learning platforms. Learning analytics can track engagement with gender-related content, participation in practice activities, performance on application exercises, and self-reported confidence ratings throughout the learning process [26]. These continuous assessment approaches complement traditional pre-post measures, providing richer insights into the development of confidence and capabilities over time.

7.5. Long-term impact assessment strategies

Assessing the long-term impact of technology-enabled gender training in project management presents significant challenges but offers crucial insights into sustainable change and return on investment. While immediate learning outcomes provide valuable indicators of training effectiveness, the ultimate goal of gender mainstreaming initiatives is to create lasting changes in individual practice, organizational culture, and project outcomes [25].

Kuppuswami and Ferreira [25] found that the organizations participating in their gender equality training demonstrated an enabling environment for more gender-equal policies, structures, and practices following the intervention. The researchers proposed ways to convert the success of training by integrating it into the broader gender equality strategy of these organizations. This research highlights the importance of examining organizational-level changes as indicators of long-term impact, looking beyond individual learning to institutional transformation.

Longitudinal assessment approaches track changes over extended periods, typically following participants for months or years after training completion. These approaches might employ periodic surveys, interviews, or focus groups to capture evolving practices, attitudes, and outcomes related to gender mainstreaming in project management [49]. Such longitudinal data reveal not only whether initial changes persist but also how they evolve and deepen over time as participants gain experience applying gender-responsive approaches in diverse project contexts.

Project outcome analysis examines the effects of gender mainstreaming on project results, looking for evidence that gender-responsive approaches enhance effectiveness, efficiency, relevance, sustainability, or impact [37]. These analyses might compare outcomes between projects managed by trained versus untrained project managers, or between projects before and after gender training initiatives. Such comparisons help demonstrate the practical value of gender mainstreaming for project success, potentially building broader support for gender-responsive approaches.

Organizational culture assessments explore changes in workplace norms, values, behaviors, and systems related to gender equality [25]. These assessments might examine policy changes, resource allocation patterns, decision-making processes, communication practices, or recognition systems following gender training initiatives. Such assessments help determine whether individual learning translates to collective changes that shape organizational environments and practices.

Community or stakeholder impact evaluations look beyond organizational boundaries to examine broader social effects of gender-responsive project management [8]. These evaluations might explore changes in community perceptions, stakeholder engagement patterns, beneficiary experiences, or social indicators related to gender equality. Such broader assessments help connect gender mainstreaming in project management to larger social change goals, demonstrating the societal relevance and impact of gender training initiatives.

Technology offers valuable tools for long-term impact assessment, including digital platforms for ongoing data collection, automated follow-up systems to maintain contact with training participants, data visualization tools to identify trends and patterns

over time, and collaborative spaces for sharing experiences and outcomes [26]. These technological approaches can reduce the resource intensity of longitudinal assessment while enhancing data quality and participant engagement.

The challenges of long-term impact assessment require innovative approaches that balance comprehensiveness with feasibility. Mixed-method designs combining quantitative indicators with qualitative insights often provide the most nuanced understanding of complex change processes [9]. Participatory evaluation approaches engaging training participants and other stakeholders in designing and conducting assessments can enhance relevance, buy-in, and utilization of findings. Theory-based evaluation linking observed changes to explicit theories of change helps attribute outcomes to specific interventions while acknowledging the influence of contextual factors.

7.6. Gender-specific considerations in evaluation

Evaluation of technology-enabled gender training requires attention to specific gender-related considerations that might influence assessment processes and outcomes. These considerations include potential gender differences in technology access and use, varying perceptions and experiences of training platforms, and the risk of reinforcing gender biases through evaluation approaches [33].

Moreira-Choez et al. [33] examined the influence of gender and academic level on the development of digital competencies in university teachers through a multidisciplinary comparative analysis. Their research revealed significant differences based on gender and academic level, suggesting that these demographic factors influence technological exposure and training. These findings highlight the importance of considering gender differences in digital competencies when evaluating technology-enabled gender training, as baseline capabilities may vary significantly among participants.

Gender differences in technology perception and acceptance represent another important consideration for evaluation. López-Martínez and Gómez-Torres [29] studied undergraduate satisfaction with e-learning teaching practices from a gender perspective, finding significant differences between male and female students. Female students reported higher levels of satisfaction with e-learning platforms, suggesting potential gender differences in receptiveness to digital learning environments. These findings indicate that evaluation instruments should consider how gender might influence satisfaction ratings and engagement metrics when assessing training effectiveness.

The measurement instruments themselves require careful gender-sensitive examination to ensure they do not inadvertently privilege particular perspectives or experiences. Miralles-Cardona, Kitta and Cardona-Moltó [31] addressed this concern by exploring measurement invariance of the Teacher Self-Efficacy for Gender Equality Practice (TEGEP) scale across genders and countries. Their finding of acceptable measurement invariance indicated that the scale could validly compare groups without systematically advantaging or disadvantaging particular genders. This approach demonstrates the importance of validating evaluation instruments for measurement equivalence across genders to ensure fair and accurate assessment.

Evaluation processes should also consider how gender-related social desirability bias might influence responses. Participants may provide what they perceive as socially acceptable answers regarding gender attitudes and behaviors, particularly in contexts where gender equality represents an institutional or societal value [4]. Evaluation approaches that incorporate indirect measures, behavioral observations, or anonymized response mechanisms may help mitigate these biases and provide more accurate insights into actual attitudes and practices.

Interpretation of evaluation results requires consideration of baseline gender dis-

parities that might influence training outcomes. Venkatesh et al. [53] found that gender, along with other factors such as age, influenced learner satisfaction with blended learning approaches. Understanding these pre-existing differences helps evaluators distinguish between training effects and baseline variations, enabling more accurate attribution of outcomes to training interventions rather than pre-existing characteristics.

Participatory approaches to evaluation design and implementation offer valuable strategies for addressing gender-specific considerations. Engaging diverse stakeholders in developing evaluation questions, methods, and interpretation frameworks helps ensure that multiple perspectives and experiences are represented [9]. This inclusive approach enhances the relevance and validity of evaluation for different genders, potentially revealing insights that might be overlooked in more standardized approaches.

8. Gender mainstreaming in Ukrainian local development projects

8.1. Current state of educational technologies in Ukrainian context

The landscape of educational technologies in Ukraine presents both promising developments and significant challenges for gender mainstreaming in project management training. Understanding this context is essential for designing effective technology-enabled approaches that address the specific needs and circumstances of Ukrainian project managers, particularly those involved in local development initiatives [5].

Digital infrastructure in Ukraine has expanded considerably in recent years, though significant disparities persist between urban and rural areas. Major cities and educational centers generally have reliable internet connectivity and access to digital devices, while rural communities often face more limited technological resources [50]. These disparities have implications for the accessibility of technology-enabled gender training, potentially reinforcing existing inequalities if not addressed through thoughtful design and implementation strategies.

Educational institutions in Ukraine have increasingly incorporated digital technologies into their teaching and learning approaches, accelerated by the global COVID-19 pandemic which necessitated rapid adoption of online and blended learning models. Universities, particularly those focused on technical and management education, have developed digital learning platforms, virtual classrooms, and online resources to support student learning [3]. These developments create potential infrastructure for technology-enabled gender training in project management education.

The field of project management education in Ukraine has evolved significantly, with growing recognition of project management as a professional discipline requiring specialized knowledge and skills. The Ukrainian Project Management Association (UPMA) and the Project Management Institute Ukraine Chapter (PMI Ukraine Chapter) have played important roles in promoting professional standards and educational approaches for project management [13]. However, gender mainstreaming has not been consistently integrated into project management curricula and professional development programs, creating opportunities for innovative educational technology interventions.

Gender disparities in Ukrainian project management are pronounced, with women significantly underrepresented in certified project management roles. According to data from the Ukrainian Project Management Association, only 27.8% of certified project managers are women [13]. Additionally, women occupy only 25% of senior leadership positions in the PMI Ukraine Chapter [14]. These disparities highlight the need for targeted educational interventions that address gender inequalities in project management education and practice.

Educational technology approaches specifically designed for gender mainstreaming in Ukrainian project management remain limited, though some promising initiatives have emerged. International donor programs supporting local development have increasingly incorporated gender training components, some of which employ digital tools and platforms [51]. However, these approaches often lack systematic integration with core project management education and professional development programs, limiting their potential impact on gender equality in the field.

The potential for innovative educational technology approaches to gender mainstreaming in Ukrainian project management is significant, particularly given the growing demand for project managers with international competencies. As Ukrainian communities and organizations increasingly engage with international donors and partners, the ability to implement gender-responsive project management approaches becomes increasingly valuable [11]. Technology-enabled training offers scalable, accessible approaches to developing these competencies among current and future project managers.

8.2. International donor initiatives supporting technology-enabled training

International donor initiatives have played significant roles in supporting technology-enabled training for gender mainstreaming in Ukrainian local development projects. These initiatives have introduced innovative approaches, resources, and platforms that enhance capacity for gender-responsive project management among Ukrainian professionals and communities [51].

The European Union's "U-LEAD with Europe: Program for Ukraine on Local Empowerment, Accountability and Development" represents one of the largest initiatives supporting local development in Ukraine, with funding of EUR 152.3 million for the implementation period 2016-2023 [51]. This program has incorporated digital learning platforms and resources for local government officials and project managers, including modules on gender mainstreaming in local development planning and implementation. These technology-enabled approaches have allowed for broader reach and more consistent delivery of gender training across diverse Ukrainian communities.

The United Nations Recovery and Peacebuilding Programme (UN RPP), with funding of USD 80 million for the implementation period 2014-2022, has also supported technology-enabled approaches to gender mainstreaming in local development projects [52]. This program has developed online learning modules, digital toolkits, and virtual communities of practice focused on gender-responsive recovery and peacebuilding approaches. These resources have supported Ukrainian project managers in integrating gender considerations into complex development initiatives, particularly in conflict-affected areas.

The "Decentralization Brings Better Results and Efficiency" (DOBRE) program, funded by USAID with USD 50 million for the implementation period 2016-2021, has incorporated digital platforms for capacity building in gender-responsive local governance [42]. These platforms have included interactive learning modules, virtual coaching sessions, and collaborative digital spaces for sharing experiences and best practices related to gender mainstreaming in local development projects. This technology-enabled approach has enhanced accessibility and sustainability of gender training for local government officials and project managers.

The "Partnership for Urban Development" (PLEDDG) project, funded by the Canadian government with CAD 19.5 million for the implementation period 2015-2020, has supported the development of digital resources for gender mainstreaming in urban development projects [38]. These resources have included online courses, webinars, and digital planning tools that incorporate gender analysis and gender-responsive budgeting approaches. The project has emphasized the use of educational technolo-

gies to build sustainable capacity for gender-responsive project management within Ukrainian municipalities.

The "E-Governance for Accountability and Participation Program" (EGAP), funded with CHF 9.4 million for the implementation period 2015-2023, has focused specifically on leveraging digital technologies for more inclusive and gender-responsive governance [16]. This program has supported the development of e-learning platforms and digital tools that enhance transparency, accountability, and citizen participation in local governance, with specific attention to ensuring equal access and benefits for women and men.

These international donor initiatives have contributed significantly to the landscape of technology-enabled gender training in Ukrainian local development, introducing innovative approaches and resources that might not otherwise be available. However, challenges remain in ensuring that these external investments translate to sustainable, locally-owned approaches that continue beyond donor funding periods [17]. Successful initiatives have emphasized knowledge transfer, local capacity building, and institutional strengthening to enhance the long-term impact of technology-enabled gender training.

8.3. Implementation challenges and opportunities

The implementation of technology-enabled gender training in Ukrainian local development projects presents distinct challenges and opportunities that shape intervention effectiveness and sustainability. Understanding these factors is essential for designing approaches that address real-world constraints while leveraging available resources and openings for innovation [5].

Language and cultural adaptation represent significant implementation challenges, as many gender training resources and platforms are developed in English or other international languages, requiring translation and cultural contextualization for effective use in Ukrainian contexts [24]. Additionally, gender concepts and approaches developed in Western contexts may require thoughtful adaptation to resonate with Ukrainian cultural perspectives and experiences. Successful implementation strategies have involved collaboration with local experts to adapt content and approaches while maintaining core gender equality principles.

Digital divides present another implementation challenge, with significant disparities in technology access and digital literacy between urban and rural areas, different age groups, and socioeconomic levels [50]. These divides risk excluding important stakeholders from technology-enabled gender training, particularly those in more marginalized communities who might benefit most from gender-responsive project approaches. Blended learning models that combine digital and face-to-face components have helped address these divides by providing multiple access points while leveraging the benefits of educational technologies.

Institutional capacity constraints affect implementation in many Ukrainian communities and organizations, where limited staff, time, and resources may restrict engagement with new training approaches regardless of their potential value [5]. Project managers already facing significant responsibilities may struggle to prioritize gender training amidst competing demands. Modular, flexible training designs that can be integrated with existing workflows and responsibilities have proven more successful than approaches requiring extensive dedicated time or additional staffing.

Political and social resistance to gender equality initiatives creates challenges in some Ukrainian contexts, where gender concepts may be perceived as foreign impositions or threats to traditional values [9]. This resistance can manifest as reluctance to participate in gender training or skepticism about its relevance to project management practice. Framing gender mainstreaming in terms of project effectiveness and inclusive

benefits, rather than focusing solely on equity arguments, has helped overcome some resistance by highlighting practical advantages of gender-responsive approaches.

Despite these challenges, significant opportunities exist for technology-enabled gender training in Ukrainian local development. The growing recognition of project management as a professional discipline creates openings for integrating gender perspectives into emerging educational and professional development approaches [13]. As project management becomes more formalized and structured, gender mainstreaming can be incorporated as a core competency rather than an optional add-on.

The increasing engagement of Ukrainian communities and organizations with international partners and donors creates opportunities for knowledge exchange and exposure to diverse approaches to gender in project management [11]. This international engagement often brings resources, expertise, and expectations related to gender mainstreaming, creating both incentives and support for developing local capacity in this area. Technology-enabled approaches can facilitate this knowledge exchange while adapting international perspectives to local contexts.

Ukraine's strong technical education tradition and growing technology sector provide foundations for innovative educational technology approaches to gender training [33]. Local expertise in digital learning design and implementation can be leveraged to develop contextually appropriate platforms and tools that address specific needs of Ukrainian project managers. This local technology capacity enhances sustainability by reducing dependence on external technical support for ongoing implementation.

The process of decentralization in Ukraine, which has transferred significant responsibilities to local communities, creates opportunities for integrating gender perspectives into newly developing local governance and project management approaches [5]. As communities establish new systems and processes for local development, gender mainstreaming can be incorporated from the beginning rather than retrofitted into existing structures. Technology-enabled training can support this integration by providing accessible guidance and tools for implementing gender-responsive approaches in new local development initiatives.

8.4. Case studies from Ukrainian communities

Examining specific case studies from Ukrainian communities provides valuable insights into the practical application of technology-enabled gender training in local development projects. These cases illustrate diverse approaches, challenges, and outcomes across different contexts, offering lessons for future initiatives [51].

The U-LEAD with Europe program implemented a blended learning initiative for gender-responsive local governance in 24 amalgamated territorial communities across four oblasts in western Ukraine between 2018 and 2020 [51]. This initiative combined an online learning platform containing interactive modules on gender analysis, gender-responsive budgeting, and inclusive citizen engagement with in-person workshops and coaching sessions. Digital collaboration tools supported ongoing peer learning and experience sharing among participating communities. Evaluation showed significant improvements in participants' knowledge and confidence regarding gender mainstreaming approaches, with 75% reporting application of learned concepts in local development projects within six months. Key success factors included the flexibility of the blended approach, which accommodated varying levels of digital access and literacy, and the creation of a supportive peer network that sustained engagement beyond formal training periods.

The DOBRE program piloted a mobile learning application for gender-responsive project planning in 15 communities in southern and eastern Ukraine during 2019-2020 [42]. This application provided just-in-time guidance for conducting gender analysis, developing gender-responsive indicators, and engaging diverse stakeholders

during project design processes. Features included downloadable resources for offline use, step-by-step planning tools, and short video tutorials demonstrating gender mainstreaming techniques. Usage data showed that 82% of registered users accessed the application during actual project planning sessions, suggesting successful integration with work processes. Challenges included varying levels of smartphone access among older community members and initial skepticism about the relevance of gender considerations to technical infrastructure projects. Adaptations included developing simplified versions of key tools that could be shared via basic text messaging and framing gender analysis as a strategy for enhancing project sustainability and community benefits.

The Partnership for Urban Development project supported the creation of an online community of practice for gender-responsive urban planning in six mid-sized Ukrainian cities during 2017-2019 [38]. This digital platform combined e-learning resources on gender in urban development with collaborative spaces for sharing challenges, solutions, and project examples. Regular virtual meetings and webinars facilitated ongoing learning and relationship building among urban planners and project managers. Participants particularly valued the opportunity to see concrete examples of gender-responsive approaches in similar Ukrainian contexts, which helped translate theoretical concepts into practical applications. The digital community of practice model proved especially valuable during the COVID-19 pandemic, when it became the primary venue for professional exchange and support when in-person networking was restricted.

The UN Recovery and Peacebuilding Programme developed a virtual simulation for gender-sensitive conflict analysis in local development projects, implemented in conflict-affected communities in eastern Ukraine during 2020-2021 [52]. This technology-enabled training tool presented participants with realistic scenarios based on actual local development challenges, requiring them to apply gender analysis to understand different impacts on women and men and develop inclusive solutions. The simulation incorporated decision points with feedback on gender implications of various choices, helping participants recognize unintended consequences of gender-blind approaches. Evaluation showed that the experiential learning approach significantly enhanced participants' ability to identify gender dimensions of conflict and development issues, with 68% demonstrating improved analysis capabilities in post-training assessments. Challenges included technical barriers for some participants and initial discomfort with the gaming-inspired format among older professionals. Adaptations included providing technical support sessions before training and framing the simulation as a professional analysis exercise rather than a game.

These case studies highlight several common success factors in technology-enabled gender training for Ukrainian local development projects: flexibility to accommodate varying technological contexts, connection to concrete local development challenges, peer learning and exchange opportunities, and integration with existing project workflows [51]. They also reveal common challenges, including digital divides, initial skepticism about gender relevance, and contextual adaptation needs. The most successful initiatives employed mixed-method approaches that leveraged educational technologies while acknowledging their limitations in specific Ukrainian contexts.

8.5. Integration with project cycle management

The integration of gender mainstreaming with project cycle management through educational technology represents a crucial approach for ensuring practical application in Ukrainian local development initiatives. This integration helps translate gender concepts from abstract principles into concrete actions within familiar project management frameworks, enhancing both understanding and implementation [20].

Project cycle management (PCM) provides a structured framework for planning, implementing, monitoring, and evaluating development projects, offering natural integration points for gender considerations throughout the project lifecycle [37]. Educational technology can support this integration by providing digital tools and resources tailored to specific phases of the project cycle, helping project managers incorporate gender perspectives at each stage of their work.

During the identification phase, digital gender analysis tools support the systematic examination of gender differences in project contexts. These tools help project managers collect and analyze sex-disaggregated data, identify gender gaps and issues, and understand different needs and priorities of women and men in target communities [20]. Technology-enabled approaches include mobile data collection applications, digital stakeholder mapping tools, and online gender analysis frameworks adapted to Ukrainian contexts. These technologies enhance the efficiency and consistency of gender analysis while making the process more accessible to project managers with limited gender expertise.

For the design and planning phase, digital platforms support the development of gender-responsive project plans, budgets, and monitoring frameworks. These platforms provide templates, checklists, and guidance for setting gender-related objectives and indicators, allocating resources to address gender-specific needs, and designing activities that promote equal participation and benefits [37]. Interactive planning tools help project managers visualize how gender considerations integrate with other project elements, ensuring comprehensive rather than siloed approaches to gender mainstreaming.

During implementation, digital monitoring systems track gender-related progress and alert project managers to potential issues requiring attention. These systems support the collection and analysis of gender-disaggregated data on project activities and outputs, helping identify differential participation patterns or benefit distribution between women and men [51]. Mobile reporting tools enable field staff to document gender-related observations and issues in real-time, facilitating responsive management and adaptation during implementation.

For evaluation and learning, educational technology supports systematic assessment of gender-related outcomes and impacts, as well as knowledge sharing across projects and communities. Digital evaluation tools help project managers assess both intended and unintended gender effects, analyze factors influencing gender-related results, and document lessons for future initiatives [48]. Online knowledge platforms facilitate the sharing of gender mainstreaming experiences across Ukrainian communities, building a collective understanding of effective approaches in local contexts.

The integration of gender considerations with project cycle management through educational technology faces several challenges in Ukrainian contexts. Limited gender expertise among many project managers creates difficulties in applying gender analysis frameworks and interpreting gender-disaggregated data, even when digital tools are available [13]. Time and resource constraints within project cycles may lead to superficial gender integration if digital tools are perceived as adding complexity rather than value. Resistance to gender considerations in certain technical sectors or communities may limit engagement with gender-focused digital resources regardless of their quality or relevance [9].

Despite these challenges, several promising approaches have emerged for enhancing integration in Ukrainian contexts. Embedding gender guidance within mainstream project management digital platforms rather than creating separate gender-specific tools helps normalize gender considerations as part of standard practice [37]. Providing practical examples and case studies from similar Ukrainian communities demonstrates the relevance and feasibility of gender integration in local contexts. Linking gender

approaches to project success criteria valued by different stakeholders – such as sustainability, community ownership, or donor requirements – helps build broader support for gender integration [20].

The most effective educational technology approaches for integrating gender with project cycle management in Ukrainian contexts emphasize practical application, contextual relevance, and efficiency. Tools that reduce rather than increase workload while enhancing project quality gain greater acceptance among time-constrained project managers. Approaches that acknowledge and build upon existing local knowledge and practices, rather than imposing external frameworks, resonate more strongly with Ukrainian communities. Technologies that facilitate collaborative problem-solving around gender issues in projects help build collective capacity and commitment to gender-responsive approaches [21].

9. Recommendations for practice

9.1. Best practices for developing technology-enabled gender training

The development of effective technology-enabled gender training for project management requires thoughtful attention to design principles, pedagogical approaches, and implementation strategies that address the specific challenges and opportunities of this interdisciplinary domain. Drawing on findings from research and practice, several best practices emerge for developing training initiatives that effectively promote gender mainstreaming in project management contexts [28].

Begin with comprehensive needs assessment that examines not only learning objectives but also contextual factors influencing training effectiveness. This assessment should consider the specific gender dynamics and challenges in targeted project management contexts, current knowledge and attitudes among potential participants, technological access and literacy levels, and organizational or institutional factors that may support or constrain application of learning [25]. Technology can support this assessment through digital surveys, virtual focus groups, and data analytics examining patterns in existing project management practices. The most effective assessments engage diverse stakeholders, including both women and men in various project roles, to ensure multiple perspectives inform training development.

Design for diverse learning preferences and contexts, recognizing that project managers bring varied backgrounds, experiences, and approaches to learning. Effective technology-enabled gender training offers multiple pathways through content, accommodating different learning styles, entry points, and application contexts [53]. This flexibility might include offering content in various formats (text, audio, video, interactive), providing both structured sequential learning paths and just-in-time resource access, and supporting different engagement intensities based on participants' roles and needs. Particularly in gender training, where personal experiences and perspectives significantly influence learning, this diversity-responsive design proves essential for engaging all participants effectively.

Incorporate authentic, contextually relevant scenarios and examples that demonstrate gender issues in realistic project management situations. Generic or abstract presentations of gender concepts often fail to resonate with project managers focused on practical application [34]. Technology enables the creation of immersive, interactive scenarios that simulate real-world project challenges with embedded gender dimensions, allowing participants to practice analysis and decision-making in safe learning environments. These scenarios should reflect the specific contexts, sectors, and types of projects encountered by participants, with careful attention to cultural relevance and authenticity.

Integrate gender concepts with core project management frameworks and tools rather

than presenting gender as a separate or additional consideration. This integration helps participants recognize gender mainstreaming as an inherent aspect of effective project management rather than an external requirement or optional enhancement [20]. Digital learning platforms can embed gender considerations within familiar project management tools and processes – such as stakeholder analysis templates, risk assessment frameworks, or monitoring dashboards – demonstrating practical implementation approaches. This integrated design helps overcome perceptions of gender as disconnected from "real" project management concerns.

Create opportunities for reflection and dialogue that help participants explore their own assumptions, experiences, and perspectives related to gender in project contexts. Transformative learning about gender requires more than knowledge acquisition; it involves examining and potentially revising deep-seated beliefs and attitudes [56]. Technology can support this reflective process through guided journaling activities, asynchronous discussion forums, anonymous polling that reveals collective perspectives, and virtual dialogue spaces that connect participants across locations and hierarchies. These reflective components help participants personalize learning and develop authentic commitments to gender-responsive approaches.

9.2. Guidelines for educational institutions

Educational institutions play crucial roles in shaping project management professionals' understanding and application of gender mainstreaming principles. Universities, training centers, and professional education providers have unique opportunities to integrate gender perspectives into formal educational pathways for project managers, establishing foundations for gender-responsive practice throughout careers [39].

Integrate gender mainstreaming across project management curricula rather than isolating it in specialized elective courses or modules. This comprehensive approach ensures that all project management students encounter gender concepts and applications throughout their educational experience, normalizing gender consciousness as an inherent aspect of professional practice [39]. Technology can support this integration through digital content repositories that provide gender-related materials, examples, and activities for diverse project management courses, helping instructors incorporate gender perspectives even without extensive gender expertise. Cross-cutting digital learning pathways can also help students connect gender concepts across different courses and topics, building cumulative understanding throughout their educational journey.

Develop faculty capacity for gender-responsive teaching in project management education through comprehensive professional development initiatives. Many project management educators lack formal preparation in gender theory or gender-responsive pedagogy, limiting their ability to effectively integrate these perspectives regardless of institutional intentions [31]. Technology-enabled approaches to faculty development might include online courses on gender in project management education, virtual communities of practice for sharing teaching strategies and resources, digital coaching or mentoring programs pairing gender experts with project management faculty, and repositories of gender-responsive teaching materials and examples. These approaches help build a core of knowledgeable faculty who can champion and model gender mainstreaming in project management education.

Create authentic assessment approaches that evaluate students' ability to apply gender analysis and mainstreaming in project management contexts. Traditional assessment methods may fail to capture development of these complex capabilities, particularly when they focus primarily on technical knowledge rather than integrated application [31]. Technology-enabled assessment approaches might include digital

project simulations requiring gender-responsive planning and decision-making, electronic portfolios documenting gender mainstreaming application in project work, peer assessment platforms for evaluating gender considerations in team projects, and reflective journals exploring personal development in gender-responsive project management. These authentic assessments signal the importance of gender mainstreaming capabilities while providing meaningful feedback for continued development.

Establish partnerships with industry and community organizations that create opportunities for applied learning about gender in project contexts. These partnerships enable students to engage with real-world gender challenges and applications, enhancing the relevance and impact of their learning [19]. Digital platforms can facilitate these partnerships through virtual project collaborations with community organizations addressing gender issues, online mentoring programs connecting students with practitioners implementing gender-responsive project approaches, digital case libraries documenting gender mainstreaming in partner organizations, and collaborative problem-solving spaces addressing gender challenges in specific project contexts. These technology-enabled partnerships extend learning beyond classroom boundaries while contributing to gender equality initiatives in partner organizations.

Conduct institutional gender audits that examine how educational institutions themselves model gender equality in project-related programs and activities. These audits help identify inconsistencies between espoused values regarding gender and actual institutional practices, creating opportunities for alignment that enhances credibility and impact [36]. Digital tools can support these audits through automated analysis of gender patterns in institutional data, anonymous feedback platforms for gathering experiences related to gender equality, visualization tools for communicating audit findings to diverse stakeholders, and collaborative planning platforms for developing improvement initiatives based on audit results. By addressing their own gender equality challenges, educational institutions strengthen their position as authentic advocates for gender mainstreaming in project management.

9.3. Strategies for project management organizations

Professional project management organizations influence standards, practices, and professional development throughout the field, positioning them as potential catalysts for advancing gender mainstreaming in project management. These organizations – including both global bodies like PMI and local associations like UPMA in Ukraine – can leverage educational technology to promote gender-responsive approaches among their members and the broader professional community [1].

Integrate gender competencies into professional standards and certification frameworks, signaling their importance for effective project management practice. This integration helps establish gender mainstreaming capabilities as core professional expectations rather than optional specializations [13]. Digital approaches supporting this integration might include online competency frameworks with embedded gender dimensions, interactive self-assessment tools for evaluating gender mainstreaming capabilities, certification management systems that track gender-related professional development, and digital badging programs recognizing specific gender mainstreaming competencies. These approaches help formalize and recognize gender mainstreaming as a valued professional capability.

Develop digital learning pathways focused specifically on gender mainstreaming in project management, providing accessible professional development opportunities for practitioners at various career stages. These pathways should address both foundational concepts and advanced applications, accommodating diverse learning needs and professional contexts [1]. Technology-enabled approaches might include modular online courses allowing customized learning journeys, microlearning resources for

just-in-time application support, virtual mentoring programs pairing gender mainstreaming experts with developing practitioners, and digital communities of practice for ongoing professional exchange. These flexible, accessible learning opportunities help practitioners develop gender mainstreaming capabilities alongside other professional responsibilities.

Create knowledge sharing platforms that capture and disseminate effective gender mainstreaming practices in diverse project contexts. These platforms help translate theoretical understanding into practical application by providing concrete examples, templates, and guidance based on actual project experiences [47]. Digital knowledge management approaches might include searchable case libraries documenting gender mainstreaming applications in various sectors and contexts, template repositories offering adaptable tools for gender analysis and planning, expert directories connecting practitioners with specialized gender expertise, and collaborative problem-solving forums addressing emerging gender challenges in project practice. These knowledge sharing approaches help build collective professional capacity for gender mainstreaming while reducing duplication of effort across the community.

Establish recognition programs that highlight exemplary gender mainstreaming in project management, creating visibility and incentives for gender-responsive approaches. These programs help counteract potential perceptions that gender considerations are secondary to "hard" project management concerns like scope, schedule, and budget [35]. Technology can support these recognition efforts through digital award platforms showcasing outstanding gender mainstreaming initiatives, social media campaigns amplifying gender equality champions in the profession, online repositories of award-winning case studies and practices, and virtual events celebrating gender mainstreaming achievements and innovations. These recognition approaches help create positive professional identities associated with gender-responsive project management.

Conduct regular gender analyses of the project management profession itself, examining patterns in participation, advancement, compensation, and experience across genders. These analyses help identify structural barriers and opportunities for enhancing gender equality within the profession [41]. Digital approaches supporting these analyses might include data visualization platforms illustrating gender patterns and trends, anonymous reporting systems for documenting gender-related challenges in professional environments, scenario planning tools for modeling potential interventions and impacts, and collaborative forums for developing profession-wide responses to identified issues. By addressing gender equality within their own profession, project management organizations enhance their credibility and capability as advocates for gender mainstreaming in project practice.

9.4. Approaches for international development agencies

International development agencies wield significant influence over project management practices through their funding requirements, technical assistance, and knowledge sharing activities. These agencies can leverage educational technology to promote gender mainstreaming in project management, particularly in contexts like Ukraine where international cooperation plays important roles in local development [51].

Harmonize gender mainstreaming requirements and approaches across donor programs to reduce confusion and compliance burdens for implementing partners. The current proliferation of different frameworks, tools, and expectations from various donors creates inefficiencies and potential superficial compliance rather than meaningful integration [17]. Digital approaches supporting harmonization might include shared online platforms for gender analysis and planning across donor programs,

interoperable data systems for gender-disaggregated monitoring and reporting, collaborative digital workspaces for coordinating gender initiatives among donors, and joint knowledge management systems capturing gender mainstreaming practices and lessons. These harmonized approaches help implementing partners develop consistent, effective gender mainstreaming capabilities applicable across multiple donor relationships.

Invest in contextually appropriate digital platforms and tools for gender mainstreaming that address specific challenges in partner countries and communities. Generic approaches developed in donor countries often fail to resonate or function effectively in different cultural, linguistic, and technological contexts [24]. Technology investments might include funding for local adaptation and translation of gender mainstreaming digital resources, support for developing mobile tools compatible with existing technology ecosystems, collaborative development of culturally relevant digital learning content with local partners, and technology infrastructure enhancements necessary for equitable access to digital gender resources. These contextually appropriate investments enhance both relevance and accessibility of gender mainstreaming approaches for local project managers.

Build sustainable local capacity for technology-enabled gender training through comprehensive institutional strengthening rather than isolated training events. Short-term training initiatives often fail to create lasting changes in project management practice, particularly when they lack supportive institutional environments for application and reinforcement [25]. Digital approaches supporting capacity development might include establishing virtual centers of excellence for gender mainstreaming within partner institutions, implementing training-of-trainers programs with ongoing virtual coaching and support, creating digital knowledge management systems owned and maintained by local institutions, and developing Communities of Practice with gradually transitioning leadership from international to local experts. These sustainability-focused approaches help create enduring local capacity that continues beyond donor program timeframes.

Support gender-responsive monitoring, evaluation, and learning systems that help implementing partners track and improve gender mainstreaming in project management. Many existing monitoring approaches focus primarily on counting female participants rather than examining meaningful changes in gender equality outcomes [37]. Technology-enabled approaches might include digital platforms for collecting and analyzing gender-disaggregated data throughout project cycles, mobile tools for gathering feedback from diverse stakeholders on gender-related experiences, collaborative learning platforms for sharing gender mainstreaming insights across projects and organizations, and visualization tools that communicate gender-related findings to various audiences. These learning-oriented approaches help partners move beyond compliance-focused monitoring to improvement-focused evaluation and adaptation.

Model gender-responsive organizational practices within donor agencies themselves, demonstrating commitment beyond external requirements. The credibility and effectiveness of gender mainstreaming advocacy depend partly on consistency between promoted approaches and internal practices [9]. Digital approaches supporting internal gender responsiveness might include gender equality dashboards tracking progress on internal commitments, online gender analysis tools for examining agency policies and procedures, virtual collaboration platforms supporting flexible work arrangements that accommodate diverse life circumstances, and digital training programs developing staff capacity for gender mainstreaming in all roles. By addressing their own gender equality challenges, donor agencies enhance their positions as authentic partners rather than merely external enforcers of gender requirements.

9.5. Policy implications

The advancement of technology-enabled gender training in project management carries significant policy implications at various levels, from organizational protocols to national regulatory frameworks. These implications merit consideration by policymakers, institutional leaders, and other stakeholders seeking to create enabling environments for effective gender mainstreaming in project management practice [36].

Educational policy frameworks require updating to incorporate gender mainstreaming competencies into core requirements for project management education and professional development. Current frameworks often position gender as a specialized or optional topic rather than a fundamental aspect of professional preparation [36]. Policy approaches supporting this integration might include revising accreditation standards to require gender mainstreaming in project management curricula, establishing funding incentives for educational institutions developing gender-responsive project management programs, creating qualification frameworks that explicitly include gender mainstreaming competencies, and implementing quality assurance mechanisms that evaluate gender integration in educational offerings. These policy adjustments help institutionalize gender mainstreaming as a standard component of project management education rather than depending on individual champion initiatives.

Organizational policies governing project management processes should incorporate explicit gender mainstreaming requirements and support mechanisms. Many current organizational policies focus primarily on technical and financial aspects of project management while remaining silent on gender considerations [25]. Policy approaches addressing this gap might include revising project approval procedures to require gender analysis during planning phases, establishing budget guidelines that allocate resources for gender-responsive activities, implementing performance management systems that recognize gender mainstreaming contributions, and creating learning and development policies that support gender-related professional growth. These organizational policy adjustments help create structural support for gender mainstreaming beyond individual commitment or awareness.

Digital inclusion policies represent another critical area requiring attention, as technology-enabled gender training depends on equitable access to digital resources and skills. Current digital divides along gender, socioeconomic, and geographical lines risk excluding important stakeholders from technology-enabled learning opportunities [50]. Policy approaches addressing these divides might include establishing infrastructure development programs targeting underserved areas, implementing digital literacy initiatives focused on groups with limited technology experience, creating accessibility standards for educational technologies to accommodate diverse needs, and providing equipment access programs for resource-constrained learners. These digital inclusion policies help ensure that technology-enabled gender training reaches those who might benefit most from gender-responsive project approaches rather than only the most digitally privileged.

Public procurement policies offer powerful leverage points for promoting gender mainstreaming in project management, particularly for government-funded projects and programs. Current procurement approaches often emphasize cost and technical criteria while neglecting gender considerations in contractor selection and project requirements [20]. Policy approaches utilizing this leverage might include establishing gender-responsive criteria in bid evaluation processes, requiring gender expertise or training among key project personnel, implementing contract provisions mandating gender-disaggregated monitoring and reporting, and creating incentive structures rewarding demonstrated gender equality outcomes. These procurement policy adjust-

ments help create market incentives for organizations to develop gender mainstreaming capabilities and apply them in publicly funded projects.

Research and innovation policies influence the development and dissemination of educational technologies for gender mainstreaming in project management. Current research funding and innovation support mechanisms may not specifically target the intersection of gender, project management, and educational technology, limiting development in this area [46]. Policy approaches addressing this gap might include establishing targeted funding streams for research on gender-responsive project management approaches, creating innovation challenges focused on technology solutions for gender mainstreaming, implementing knowledge transfer programs connecting researchers with practitioners, and developing open access requirements for publicly funded research outputs to enhance dissemination. These research and innovation policies help build the evidence base for effective approaches while stimulating the development of new tools and methodologies.

The most effective policy approaches for supporting technology-enabled gender training in project management recognize the interconnected nature of these various domains, creating comprehensive frameworks that address educational, organizational, technological, procurement, and research dimensions simultaneously. By aligning policies across these areas, policymakers can create enabling environments that support gender mainstreaming throughout project management education and practice, enhancing the impact of technology-enabled training initiatives.

10. Conclusion and future research directions

10.1. Summary of key findings

This comprehensive examination of educational technology for gender mainstreaming in project management has revealed several key findings that contribute to understanding the current landscape, challenges, and opportunities in this interdisciplinary domain. These findings span theoretical frameworks, practical applications, case studies, and evaluation approaches, providing a multifaceted view of how educational technology can enhance gender training for project managers.

The evolution of gender mainstreaming concepts has shifted from viewing gender primarily as a policy concern to recognizing it as an integral component of effective project cycle management. This conceptual evolution creates both opportunities and challenges for educational technology interventions, which must translate increasingly sophisticated understandings of gender dynamics into accessible, practical learning experiences for project management professionals [9]. The most effective approaches integrate gender considerations with core project management frameworks and tools rather than presenting gender as a separate or additional consideration.

Women remain significantly underrepresented in project management, particularly in leadership roles and technical sectors, despite growing evidence of the benefits of gender diversity for project outcomes [41]. This persistent underrepresentation creates both a rationale for gender mainstreaming education and challenges for its implementation, as predominantly male professional communities may demonstrate less initial engagement with gender topics. Educational technology interventions must navigate these dynamics thoughtfully, framing gender mainstreaming in terms relevant to diverse project managers while creating inclusive learning environments.

Blended learning approaches have demonstrated particular effectiveness for gender mainstreaming education in project management, combining the accessibility and scalability of online components with the interpersonal engagement and practice opportunities of face-to-face elements [55]. This hybrid approach accommodates the complex, sometimes sensitive nature of gender-related learning while providing

practical application opportunities essential for translating understanding into action. The specific blend of digital and in-person components should be tailored to learning objectives, audience characteristics, and contextual constraints.

Virtual Learning Environments (VLEs) offer promising approaches for creating safe, experiential learning spaces for gender mainstreaming in project management. These environments allow learners to engage with gender issues in simulated project contexts, practicing analysis and decision-making without real-world consequences while still experiencing authentic challenges [34]. The creation of this "third space" for learning – neither purely academic nor purely workplace-based – proves particularly valuable for developing complex capabilities like gender analysis and gender-responsive planning.

Mobile learning frameworks have emerged as valuable approaches for providing just-in-time gender guidance at the point of application, particularly in contexts where access to traditional educational resources may be limited [28]. These frameworks emphasize the importance of gender-inclusive design in mobile learning experiences, including considerations of content, language, visual representation, and assessment approaches. The portability and flexibility of mobile learning create unique advantages for supporting gender mainstreaming in diverse project environments.

Evaluation of technology-enabled gender training requires attention to multiple dimensions of impact, from immediate learning outcomes to long-term behavior change and organizational transformation [48]. The most comprehensive evaluation approaches combine the Knowledge, Attitude, Skills (KAS) model with elements of the Technology Adoption Model (TAM) and measures of self-efficacy and behavioral change, creating multifaceted assessment frameworks that capture both learning and application. Gender-specific considerations in evaluation include potential measurement differences across genders, varying baseline capabilities, and the influence of social desirability bias on self-reported data.

Case studies of educational technology interventions for gender mainstreaming reveal the importance of contextual adaptation, institutional support, and integration with existing project management practices [2, 19, 21]. Project-Based Learning approaches have demonstrated particular effectiveness for engaging learners with gender issues while developing technical project management skills, creating integrated rather than siloed learning experiences. Implementation challenges across cases include resistance to gender concepts, limited technological infrastructure, varying digital literacy levels, and difficulties translating learning to practice in unsupportive organizational environments.

The Ukrainian context presents both specific challenges and opportunities for technology-enabled gender training in project management. Digital divides between urban and rural areas, language and cultural adaptation needs, institutional capacity constraints, and varying levels of engagement with gender equality concepts all influence implementation possibilities [5]. International donor initiatives have introduced various technology-enabled approaches to gender mainstreaming in Ukrainian local development projects, with the most successful examples demonstrating flexibility, contextual relevance, peer learning opportunities, and integration with existing project workflows.

10.2. Implications for theory and practice

The findings from this research carry significant implications for both theoretical understandings and practical applications related to educational technology, gender mainstreaming, and project management. These implications suggest directions for conceptual development, methodological approaches, and professional practice in this interdisciplinary domain.

For theoretical development, this research highlights the need for more integrated

conceptual frameworks that connect gender, project management, and educational technology domains. Current theoretical approaches often address these areas separately, limiting understanding of their intersections and interactive effects [46]. More comprehensive frameworks would help explain how gender dynamics influence project management practices and outcomes, how educational technologies mediate learning about gender in professional contexts, and how these elements interact within specific cultural and organizational environments. Such theoretical integration would enhance the foundation for both research and practice in this interdisciplinary space.

The findings suggest the importance of culturally contextual approaches to gender mainstreaming theory, recognizing that gender conceptualizations and expressions vary significantly across cultural contexts [9]. Universal or Western-centric theoretical frameworks may fail to capture the specific gender dynamics and challenges in diverse project management environments, limiting their explanatory and practical value. More culturally nuanced theoretical approaches would enhance understanding of how gender mainstreaming manifests and functions in different contexts, supporting more effective educational technology interventions tailored to specific cultural settings.

For methodological development, the research indicates the value of mixed-method approaches that capture both quantitative measures of learning outcomes and qualitative insights into experience and application [9]. The complex, multidimensional nature of gender mainstreaming in project management requires equally sophisticated methodological approaches that examine not only what is learned but how that learning translates to practice in diverse contexts. Longitudinal designs prove particularly valuable for understanding the developmental trajectory of gender mainstreaming capabilities and the factors influencing their application over time.

Participatory research methodologies emerge as especially appropriate for this domain, engaging diverse stakeholders as co-researchers rather than merely subjects [56]. These approaches help ensure that research questions, methods, and interpretations reflect multiple perspectives and experiences, enhancing both the validity and utility of findings. Participatory methodologies also model the inclusive, collaborative approaches advocated within gender mainstreaming itself, creating alignment between research process and content.

For educational practice, the findings highlight the importance of integrating gender mainstreaming throughout project management curricula rather than isolating it in specialized courses or modules [39]. This comprehensive approach helps students recognize gender as an inherent aspect of effective project management rather than an optional specialization or external requirement. Educational technology can support this integration through shared repositories of gender-related content and activities applicable across diverse project management courses, helping instructors incorporate gender perspectives even without extensive gender expertise.

The research underscores the value of authentic, practice-based learning approaches that engage students with real-world gender challenges in project contexts [19]. These approaches help bridge the gap between theoretical understanding and practical application, developing not only knowledge but also skills and confidence for implementing gender-responsive approaches. Educational technologies supporting these practice-based approaches include simulations, virtual collaboration platforms, and digital case libraries that bring authentic project scenarios into educational environments.

For project management practice, the findings emphasize the importance of embedding gender considerations within standard project management tools and processes rather than creating separate “gender tracks” disconnected from mainstream practice [20]. This integration helps project managers recognize gender mainstreaming as an inherent aspect of professional excellence rather than an additional burden or external requirement. Digital platforms can support this integration by incorporating gender

prompts and guidance within common project management tools, normalizing gender considerations as part of standard practice.

The research highlights the value of digital knowledge sharing platforms that connect practitioners across organizations and contexts, facilitating exchange of gender mainstreaming approaches, challenges, and solutions [47]. These platforms help build collective professional capacity while reducing duplication of effort, supporting more effective gender mainstreaming implementation across the field. Collaborative digital environments that encourage honest sharing of both successes and challenges prove particularly valuable for addressing the complex, context-sensitive nature of gender mainstreaming in project practice.

10.3. Limitations of current research

While this study provides valuable insights into educational technology for gender mainstreaming in project management, several limitations must be acknowledged. These limitations affect the comprehensiveness, generalizability, and practical applicability of the findings, suggesting caution in their interpretation and application.

The geographical and cultural scope of the research base represents a significant limitation, with most studies and examples originating from Western European and North American contexts [9]. This geographical concentration limits understanding of how educational technology for gender mainstreaming functions in other cultural contexts, particularly in Global South regions where gender dynamics and technological environments may differ substantially. Even within the Ukrainian focus of this research, the limited availability of systematic studies on gender in Ukrainian project management constrains the depth and specificity of findings relevant to this context.

Methodological limitations affect the research base, with many studies employing small samples, short timeframes, or limited methodological approaches [9]. Few studies track long-term impacts or behavioral changes resulting from educational technology interventions, limiting understanding of sustained effects beyond immediate learning outcomes. The predominance of self-reported data in many studies introduces potential social desirability bias, particularly relevant in gender-related research where participants may provide what they perceive as socially acceptable responses rather than accurate reflections of attitudes or behaviors.

Technological evolution outpaces research publication, creating challenges for understanding current best practices in rapidly changing digital environments [27]. Studies examining specific technological approaches may become quickly outdated as new platforms, tools, and methods emerge, limiting the practical applicability of findings. This rapid evolution makes systematic knowledge accumulation challenging, as researchers and practitioners must constantly adapt to changing technological possibilities and constraints.

Interdisciplinary integration remains limited across the research base, with most studies positioned primarily within either gender studies, project management, or educational technology domains rather than at their intersections [46]. This disciplinary fragmentation constrains development of integrated understanding that addresses the complex interactions between gender dynamics, project management processes, and educational technologies. The limited collaboration between academic researchers and practitioners further constrains development of practically relevant, theoretically sound approaches to this interdisciplinary domain.

The complex, context-dependent nature of gender mainstreaming itself presents inherent research challenges that limit generalizability of findings [9]. Gender dynamics vary significantly across cultural, organizational, and sectoral contexts, making universal conclusions or recommendations difficult to establish. This contextual specificity suggests the need for cautious adaptation of findings to particular environments

rather than direct application of approaches developed in different contexts.

The sensitive nature of gender topics in some environments may affect research participation and reporting, potentially creating selection biases in study samples and response biases in data collection [9]. Those most resistant to gender mainstreaming may be least likely to participate in related research, limiting understanding of barriers and resistance factors. This sensitivity may also constrain honest reporting of challenges, failures, or negative outcomes, creating potential publication bias toward successful interventions and approaches.

Despite these limitations, the findings presented in this research provide valuable insights into the current state and potential of educational technology for gender mainstreaming in project management. By acknowledging these constraints explicitly, this study contributes to more reflective, nuanced understanding of this complex domain while highlighting areas requiring further investigation and methodological development.

10.4. Recommendations for future studies

The limitations and gaps identified in current research suggest several promising directions for future studies that would enhance understanding of educational technology for gender mainstreaming in project management. These recommendations address methodological approaches, topical focus areas, and research contexts that merit further investigation.

Longitudinal studies examining the developmental trajectory of gender mainstreaming capabilities among project managers would provide valuable insights into how these complex competencies evolve over time [48]. Such studies should track not only knowledge development but also attitudinal changes, skill application, and impact on project practices and outcomes. Ideally, these longitudinal approaches would follow participants from formal education through professional practice, examining how educational technology interventions influence capability development across career stages and diverse project contexts.

Comparative studies across different cultural contexts would enhance understanding of how gender mainstreaming approaches through educational technology function in diverse environments [24]. These studies should examine how cultural factors influence the conceptualization of gender, the acceptance and utilization of educational technologies, and the application of gender mainstreaming in project practice. Particular emphasis on non-Western contexts would help address the geographical imbalance in current research, providing more globally representative understanding of this domain.

More robust methodological approaches would strengthen the evidence base for educational technology interventions in gender mainstreaming. Mixed-method designs combining quantitative measures of learning outcomes with qualitative exploration of experiences and application contexts offer particularly promising approaches for this complex domain [9]. Experimental and quasi-experimental studies comparing different technological approaches or pedagogical strategies would help identify more effective intervention designs. Participatory research methods engaging diverse stakeholders as co-researchers would enhance both the validity and utility of findings while modeling inclusive approaches.

Studies examining resistance to gender mainstreaming and strategies for addressing this resistance would provide valuable insights for more effective educational technology interventions [9]. These studies should explore the sources, manifestations, and impacts of resistance across different contexts, as well as the effectiveness of various technological and pedagogical approaches for engaging reluctant learners. Understanding how educational technologies might mitigate or exacerbate resistance

would enhance design of more universally effective gender training approaches.

Research on the integration of emerging technologies – such as artificial intelligence, virtual and augmented reality, adaptive learning systems, and advanced analytics – for gender mainstreaming education would help identify innovative approaches to this complex learning domain [27]. These studies should examine not only the technical possibilities of these technologies but also their pedagogical applications, accessibility implications, and effectiveness for diverse learners. Particular attention to potential gender biases embedded within these technologies themselves would ensure that they advance rather than undermine gender equality goals.

Studies examining the economic and organizational impacts of technology-enabled gender training would help build the business case for investment in these approaches [23]. These studies should explore returns on investment in terms of project outcomes, team performance, stakeholder satisfaction, and organizational reputation, connecting gender mainstreaming capabilities to tangible business benefits. Understanding these impacts would help advocates secure resources and support for gender training initiatives while addressing potential skepticism about their practical value.

Research specifically focused on the Ukrainian context would enhance understanding of how educational technology can support gender mainstreaming in this important transitional environment [5]. These studies should examine the specific gender dynamics in Ukrainian project management, the technological landscape affecting educational accessibility, and the cultural factors influencing gender mainstreaming acceptance and application. Such contextually specific research would support development of more effective approaches tailored to Ukrainian realities while contributing to broader understanding of gender mainstreaming in transitional contexts.

Collaborative research initiatives connecting academics and practitioners across disciplines would enhance both the theoretical soundness and practical relevance of findings [9]. These collaborations should engage gender studies scholars, project management professionals, educational technologists, and other relevant experts in co-created research addressing shared questions and challenges. Such interdisciplinary approaches would help bridge current disconnections between theoretical understanding and practical application, supporting more integrated knowledge development in this complex domain.

10.5. Concluding remarks

Educational technology offers significant potential for enhancing gender mainstreaming in project management, providing innovative approaches to developing the complex capabilities required for gender-responsive practice. This potential extends beyond simply delivering gender-related content more efficiently; it encompasses creating transformative learning experiences that challenge assumptions, develop practical skills, and build commitment to gender equality in professional practice [28].

The intersection of educational technology, gender mainstreaming, and project management represents a particularly fertile ground for innovation and impact. Project management's growing importance across sectors and domains creates opportunities for widespread influence through gender-responsive approaches. The practice-oriented nature of project management provides concrete contexts for applying gender concepts, helping translate theoretical understanding into practical action. The increasing technological sophistication of both educational approaches and project management practice creates natural synergies for technology-enabled gender training interventions [1].

The most promising approaches emerging from this research emphasize integration rather than isolation – embedding gender perspectives within mainstream project management education and practice rather than treating them as separate considerations.

This integrated approach helps normalize gender consciousness as an inherent aspect of professional excellence rather than an external requirement or specialized niche [20]. Educational technologies can support this integration by incorporating gender considerations within familiar project management frameworks, tools, and processes, making gender mainstreaming both accessible and relevant to diverse practitioners.

Contextual adaptation emerges as a critical success factor for educational technology interventions in this domain. Generic approaches developed without consideration of specific cultural, organizational, and technological contexts often fail to resonate or function effectively in different environments [24]. The most effective interventions demonstrate responsiveness to local gender dynamics, technological landscapes, educational traditions, and professional practices, adapting general principles to specific implementation contexts. This contextual sensitivity enhances both relevance and accessibility, increasing the potential impact of gender mainstreaming education.

The complexity and sensitivity of gender as a topic require thoughtful pedagogical approaches that acknowledge diverse perspectives, experiences, and starting points. Educational technologies can support this pedagogical sophistication through personalized learning pathways, safe spaces for exploration and dialogue, authentic application opportunities, and reflective activities that help learners connect concepts to their own professional contexts [56]. These approaches recognize that effective gender mainstreaming education involves not only knowledge acquisition but also attitudinal development and skill building, requiring multifaceted learning experiences.

The collaborative nature of effective gender mainstreaming suggests the value of community-based approaches to learning and practice development. Educational technologies can facilitate these collaborative approaches through virtual communities of practice, knowledge sharing platforms, peer learning networks, and collaborative problem-solving spaces that connect diverse practitioners across organizations and contexts [47]. These community-based approaches help build collective capacity while providing ongoing support for implementation challenges that emerge in practice.

While acknowledging the significant potential of educational technology for gender mainstreaming in project management, this research also recognizes the importance of broader systemic approaches that address structural barriers to gender equality in the profession. Technology-enabled gender training represents one component of comprehensive change strategies that must also include policy development, institutional transformation, professional standards evolution, and cultural change initiatives [9]. The most effective approaches integrate educational interventions with these broader change strategies, creating mutually reinforcing pathways toward more gender-responsive project management practice.

The journey toward gender-responsive project management through educational technology requires ongoing commitment, innovation, and collaboration among diverse stakeholders – educators, professional organizations, technology developers, researchers, policy makers, and practitioners. By working together across these domains, we can develop more effective approaches to gender mainstreaming education that enhance both professional excellence and social equity through project management practice.

Declaration on generative AI: During the preparation of this work, the authors used Claude 3.7 Sonnet to improve writing style. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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